Reference Manual

MDS Mercury™ Series

MDS MERCURY 900™-R
PWR
LAN
COM1
GPS
LINK
MDS
WARNING - Do not disconnect while circuit is live unless area is known to be nonhazardous.
PWR
10-30 VDC 2.5A max
LAN
COM1
RX2
TX/RX1

Wireless IP/Ethernet Transceiver

Covering all AP and Remote Units
including Mercury 900, 3650, and Remotes with WiFi

05-4446A01, Rev. F
NOVEMBER 2009

Digital Energy
MDS

Need Quick-Start instructions for this product? Please refer to publication 05-4558A01.
*All GE MDS user guides are available online at **www.gemds.com***

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Copyright Notice

ISO 9001 Registration

GE MDS adheres to the internationally-accepted ISO 9001 quality system standard.

To our Customers

We appreciate your patronage. You are our business. We promise to serve and anticipate your needs. We will strive to give you solutions that are cost effective, innovative, reliable and of the highest quality possible. We promise to build a relationship that is forthright and ethical, one that builds confidence and trust.

Related Materials on the Internet—Data sheets, frequently asked questions, case studies, application notes, firmware upgrades and other updated information is available on the GE MDS Web site at www.gemds.com.

About GE MDS

Over two decades ago, GE MDS began building radios for business-critical applications. Since then, we have installed thousands of radios in over 110 countries. To succeed, we overcame impassable terrain, brutal operating conditions and disparate, complex network configurations. We also became experts in wireless communication standards and system applications worldwide. The result of our efforts is that today, thousands of utilities around the world rely on GE MDS-based wireless networks to manage their most critical assets.

The majority of GE MDS radios deployed since 1985 are still installed and performing within our customers' wireless networks. That’s because we design and manufacture our products in-house, according to ISO 9001 which allows us to control and meet stringent global quality standards.

Thanks to our durable products and comprehensive solutions, GE MDS is the wireless leader in industrial automation—including oil and gas production and transportation, water/wastewater treatment, supply and transportation, electric transmission and distribution and many other utility applications. GE MDS is also at the forefront of wireless communications for private and public infrastructure and online transaction processing. Now is an exciting time for GE MDS and our customers as we look forward to further demonstrating our abilities in new and emerging markets.

As your wireless needs change you can continue to expect more from GE MDS. We'll always put the performance of your network above all. Visit us at www.gemds.com for more information.

Product Test Data Sheets

Test Data Sheets showing the original factory test results for this unit are available upon request from the GE MDS Quality Leader. Contact the factory using the information at the back of this manual. Serial numbers must be provided for each product where a Test Data Sheet is required.

OPERATIONAL & SAFETY NOTICES

RF Exposure

(900 MHz models)

Professional installation required. The radio equipment described in this guide emits radio frequency energy. Although the power level is low, the concentrated energy from a directional antenna may pose a health hazard. Do not allow people to come closer than 23 cm (9 inches) to the antenna when the transmitter is operating in indoor or outdoor environments. More information on RF exposure is on the Internet at www.fcc.gov/oet/info/documents/bulletins.

To meet co-location requirements, the FCC requires a 20cm (7.87 inch) separation distance between the unit’s WIFI and fundamental antenna installations. See *“EIRP Compliance at 900 MHz”* on Page 173 for allowable power/antenna settings for this radio.

RF Exposure

(3650 MHz models)

Professional installation required. The transceiver described here emits radio frequency energy. Although the power level is low, the concentrated energy from a directional antenna may pose a health hazard. Do not allow people to come closer than 22 cm (8.7 inches) to the antenna when the transmitter is operating. This calculation is based on an 18 dBi panel antenna. Refer also to the table below, which lists required separation distances. Additional information on RF exposure is available on the Internet at www.fcc.gov/oet/info/documents/bulletins. See *“EIRP Compliance at 3650 MHz”* on Page 174 for allowable power/antenna settings for this radio.

To meet co-location requirements, the FCC requires a 20cm (7.87 inch) separation distance between the unit’s WIFI and fundamental antenna installations.

Consult insert sheet (if any) for RF Exposure information on other frequency bands.

CSA/us Notice (Remote Transceiver Only)

This product is approved for use in Class 1, Division 2, Groups A, B, C & D Hazardous Locations. Such locations are defined in Article 500 of the National Fire Protection Association (NFPA) publication *NFPA 70*, otherwise known as the National Electrical Code.

The transceiver has been recognized for use in these hazardous locations by the Canadian Standards Association (CSA) which also issues the US mark of approval (CSA/US). The CSA Certification is in accordance with CSA STD C22.2 No. 213-M1987.

CSA Conditions of Approval: The transceiver is not acceptable as a stand-alone unit for use in the hazardous locations described above. It must either be mounted within another piece of equipment which is certified for hazardous locations, or installed within guidelines, or conditions of approval, as set forth by the approving agencies. These conditions of approval are as follows:

The transceiver must be mounted within a separate enclosure which is suitable for the intended application.

The antenna feedline, DC power cable and interface cable must be routed through conduit in accordance with the National Electrical Code.

Installation, operation and maintenance of the transceiver should be in accordance with the transceiver's installation manual, and the National Electrical Code.

Tampering or replacement with non-factory components may adversely affect the safe use of the transceiver in hazardous locations, and may void the approval.

A power connector with screw-type retaining screws as supplied by GE MDS must be used.

⚠ WARNING

EXPLOSION HAZARD!

Do not disconnect equipment unless power has been switched off or the area is known to be non-hazardous.

Refer to Articles 500 through 502 of the National Electrical Code (NFPA 70) for further information on hazardous locations and approved Division 2 wiring methods.

FCC Part 15 Notices

The transceiver series complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation. This device is specifically designed to be used under Section 15.247 of the FCC Rules and Regulations. Any unauthorized modification or changes to this device without the express approval of Microwave Data Systems may void the user's authority to operate this device. Furthermore, the Mercury Series is intended to be used only when installed in accordance with the instructions outlined in this manual. Failure to comply with these instructions may also void the user's authority to operate this device.

Part 15 rules also require that the Effective Isotropic Radiated Power (EIRP) from a Mercury Series 900 MHz installation not exceed 36 dBm. For the Mercury 3650, EIRP must not exceed 1-watt per MHz. Refer to this manual for more information.

Industry Canada RSS Notices

Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

To reduce potential radio interference to other users, the antenna type and its gain should be chosen so that the Equivalent Isotropic Radiated Power (EIRP) is not more than that permitted for successful communication.

This device has been designed to operate with the antennas listed in this manual. Antennas not included here are strictly prohibited for use with this device. The required antenna impedance is 50 ohms.

Manual Revision and Accuracy

This manual was prepared to cover a specific version of firmware code. Accordingly, some screens and features may differ from the actual unit you are working with. While every reasonable effort has been made to ensure the accuracy of this guide, product improvements may also result in minor differences between the manual and the product shipped to you. If you have additional questions or need an exact specification for a product, please contact our Customer Service Team using the information at the back of this guide. In addition, manual updates can often be found on the GE MDS Web site at www.gemds.com.

Environmental Information

The manufacture of this equipment has required the extraction and use of natural resources. Improper disposal may contaminate the environment and present a health risk due to hazardous substances contained within. To avoid dissemination of these substances into our environment, and to limit the demand on natural resources, we encourage you to use the appropriate recycling systems for disposal. These systems will reuse or recycle most of the materials found in this equipment in a sound way. Please contact GE MDS or your supplier for more information on the proper disposal of this equipment.

1 PRODUCT OVERVIEW AND APPLICATIONS

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1.1 ABOUT THIS MANUAL

This *Reference Manual* is one of two publications provided for users of the Mercury Series™ transceiver system. It contains detailed product information, an overview of common applications, a screen-by-screen review of the menu system, technical specifications, suggested settings for various scenarios, and troubleshooting information. This manual should be available to all personnel responsible for network design, setup, commissioning and troubleshooting of the radios.

1.1.1 Start-Up Guide

The Mercury Series *Start-Up Guide* (Part No. 05-4558A01) is a companion publication to the Reference Manual. It is a smaller book, with a specific purpose—to guide an installer in the basic steps for getting a transceiver on the air and communicating with other units in a network. It provides only the essential information installers need for getting their equipment up and running in the shortest time possible.

1.1.2 Online Access to Manuals

In addition to printed manuals, many users need access to documents electronically. This is especially useful when you need to access documentation while traveling, or want to share a document with another user in the field. Electronic documents also allow searching for a specific term or subject, especially in larger manuals.

Access manuals for our equipment anytime from our Web site at **www.GEmds.com**. Simply click the **Downloads** tab at the top of the home page and select **Product Manuals** from the drop-down list. A search window appears to help you locate the manual you need.

Online manuals are provided as PDF files in the Adobe® Acrobat® standard. If necessary, download the free reader for PDF files from **www.adobe.com**.

1.1.3 Conventions Used in This Manual

On-Screen Menu Items

On-screen menu items or command entries are presented in a distinctive font to set them apart from regular text (for example: **Network Name, IP Address, Password**). You will find this font most often in Chapter 3, where the menu system is discussed in detail. When variable settings or a range of options are available for a menu option, the items are presented inside brackets, with the default setting (if any) shown last after a semicolon:

[**available settings or range; default setting**]

Menu Strings

To help show the path to a menu selection, navigation strings are used in several places in this manual. For example, suppose you want to view or set the Network Name assigned to your system. This item is located in the Network Configuration Menu, so the navigation string in the text would appear as shown:

Main Menu>>Network Configuration>>Network Name

By following this order of menus, you can quickly reach the desired menu.

1.2 PRODUCT DESCRIPTION

The GE MDS Mercury Series™ transceiver (Figure 1-1) is an easy-to-install wireless solution offering extended range, secure operation, and multi-megabit performance in a compact and rugged package. The transceiver is ideally suited for demanding applications in fixed or mobile environments, where reliability and range are paramount.

The transceivers are commonly used to convey text documents, graphics, e-mail, video, Voice over IP (VoIP), and a variety of other application data between mobile, fixed-point, and WAN/LAN-based entities.

Based on multi-carrier Orthogonal Frequency Division Multiplexing (OFDM), the transceiver features high speed/low latency, basic Quality of Service (QoS) for prioritizing traffic, Ethernet and serial encapsulation, and network roaming. It also provides enhanced security features including AES encryption and IEEE 802.1x Device Authentication, making the Mercury system the best combination of security, range, and speed of any industrial wireless solution on the market today.

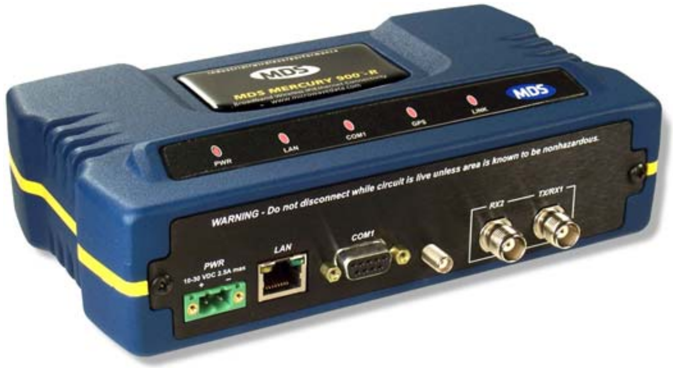
MDS MERCURY 900 - R
MDS
PWR
LAN
COM1
GPS
LINK
WARNING - Do not disconnect while circuit is live unless area is known to be nonhazardous.
RX2
TX/RX1
PWR
10-30 VDC 2.5A max
LAN
COM1

Figure 1-1. The GE MDS Mercury Series™ Transceiver
(Remote unit shown, AP similar in appearance)

Rugged Packaging The transceivers are housed in a compact and rugged die cast-aluminum case that needs only protection from direct exposure to the weather. This one enclosure contains all necessary components for radio operation and data communications.

Simple Installation

Mercury Transceivers are designed for rapid and trouble-free installation. For basic services, you simply connect the antennas (900 or 3650 MHz as required, and GPS), connect your data equipment, apply primary power, and set some operating parameters. No license is required for 900 MHz operation in the USA, Canada, and many other countries. A simple registration process is required for 3650 MHz operation in the USA. Check requirements for your region before placing the equipment into service. (NOTE: 3650 MHz is for APs and Fixed Remote stations.)

Most installations employ an omni-directional antenna at the Access Point (AP) location and mobile stations. Fixed Remote stations often employ a directional antenna aimed at the AP. Regardless of the type used, antennas are a vital part of the system and must be chosen and installed correctly. Refer to *INSTALLATION PLANNING* on Page 165 for guidance on choosing suitable antennas and installation sites.

Secure Operation

Data network security is a vital issue in today’s wireless world. Mercury transceivers provide multiple tools to help you build a network that minimizes the risk of eavesdropping and unauthorized access. Some are inherent in the radio’s operation, such as the use of 900 MHz spread-spectrum transmissions; others include AES data encryption, enabling/disabling channels, IEEE 802.1X port blocking, approved device lists, secure devices management protocols, and password protection.

Security is not a one-step process that can simply be turned on and forgotten. It must be practiced and enforced at multiple levels, 24 hours-a-day and 7 days-a-week. See *“GE MDS CYBER SECURITY SUITE”* on Page 17 for more information about the transceiver’s security tools.

Robust Radio Operation

The transceivers are designed for operation in the 900 MHz license-free Industrial, Scientific, and Medical (ISM) band and the 3650-3700 MHz registered band. They provide consistent, reliable coverage over a large geographic area.

Mobile range depends on many factors, including terrain, building density, antenna gain, and speed of travel. The unit is designed for successful application in a variety of mobile environments, and offers the best combination of range, speed and robustness available in an industrial wireless package today. By using multiple Access Points, a network can be created that provides consistent, reliable coverage over a large metropolitan area. See *“SPECIFICATIONS”* on Page 180 for more information on transmission range.

Flexible Services

Users with a mix of equipment having Ethernet and serial data interfaces can use this equipment via a Remote transceiver. The transceiver provides services in data networks that are migrating from legacy serial/EIA-232-based hardware to the faster and more easily interfaced Ethernet protocol.

Flexible Management

You can locally or remotely configure, commission, troubleshoot, and maintain the transceiver. Four different modes of access are available: local RS-232 console terminal, local or remote IP access (via Telnet or SSH), web browser (HTTP, HTTPS), and SNMP (v1/v2/v3) All IP access interfaces are available through the unit's wired Ethernet port and over the air.

The text-based interfaces (RS-232 console, Telnet, and SSH) are implemented in the form of easy-to-follow menus, and the terminal server provides a wizard to help you configure the units correctly.

Transceiver Features

The transceiver's design makes the installation and configuration easy, while allowing for future changes.

- Industrial-Grade Product—Extended temperature range for trouble-free operation in extreme environments.
- Robust Radio Communications—Designed to operate over long distances in dense, high-interference environments.
- Robust Network Security—Prevents common attack schemes and hardware from gaining access or control of the network. Common attack events are logged and reported by alarms.
- Transmission Speed—Operation at 1.5 Mbps is over 100-times faster than 9.6 kbps radios.
- Plug-and-Play Connectivity—AP or Remote configuration requires minimal setup.
- Built-in GPS Receiver—GPS technology is used for timing and location data. The only external equipment needed for this functionality is a GPS antenna available from GE MDS).

1.2.1 Model Offerings

The transceiver comes in two primary models—Access Point and Remote. Unique hardware is used for each model. Of the Remote radios, there are two sub-types available—**Standard Remote** and **Remote with WiFi**, both of which support Ethernet and serial services. (A Remote with WiFi includes a second Ethernet port and USB Management Port.) Table 1-1 summarizes each radio's interface services.

Table 1-1. Transceiver Models and Data Interface Services

Model	Sub-Type	Ethernet/LAN[1]	COM1[1]	USB	Integrated WiFi
Access Point	N/A	Yes	Yes	No	No
Remote	Standard Remote	Yes	Yes	No	No
	Remote with WiFi	Yes	Yes	Yes	Yes

NOTES
1. COM1 provides access to the embedded Management System for all units.

Available Frequency Bands

At the time of publication, Mercury transceivers are offered in two different frequency bands: 902-928 MHz (Mercury 900) and 3.65–3.70 GHz (Mercury 3650). The 900 MHz unit operates in a license-free spectrum (frequency hopping spread spectrum—FHSS), which may be used by anyone in the USA, provided FCC Part 15 rules are observed. Canada, and certain other countries allow license-free operation in this band—check your country's requirements.

The 3.65–3.70 GHz radio operates in a "registered" band using contention-based protocol, which provides additional protection from interference, but it requires FCC registration before operation can begin. Other restrictions may apply based on your location and "grandfathered" FSS users. Check local requirements before operation. GE MDS has published a whitepaper containing frequently asked questions about the 3.65–3.70 GHz band. To obtain a copy, request publication 05-4734A02. (NOTE: 3650 MHz is for APs and Fixed Remote stations.)

Operationally, the Mercury 3650 has two key differences from the Mercury 900: First, it operates on a different RF band (3.65–3.70 GHz). Second, it only requires GPS for TDD synchronization of the Access Points, which may or may not be needed for an installation.

Access Point or Remote?—Identification Tip

The outward appearance of AP and Remote radios is nearly identical, however, the hardware for each type is different and they are *not* interchangeable. An quick way to identify them is to observe the color of the gasket seal in the center of the radio case. **APs have a black gasket, while Remote units have a yellow gasket.**

In addition to gasket color, a label on the top of each radio identifies it as an AP or Remote unit. If the label shows an –A suffix, it is an AP. If it shows a –R suffix, it is a Remote.

1.2.2 Remote Radio with WiFi

The Mercury Remote with WiFi is similar to and compatible with the standard Remote. It contains the same 900 MHz radio, user interface, and primary functionality as the Standard Remote. The Standard Remote can be *directly replaced* with the WiFi Remote. The key differences are the additional physical interfaces: an IEEE 802.11b/g WiFi networking module, a USB device port, a USB host port, and a second Ethernet port on the radio enclosure.

The USB ports are used for device management. The host port accepts a flash drive and can be used to transfer firmware and configuration files. The two Ethernet ports are connected to an internal, integrated switch and included in the Layer 2 bridge.

The internal WiFi module has FCC modular approval and may only be operated by connecting one of the GE MDS approved antennas (see *802.11 WiFi Module Specifications* below) to the reverse-SMA connector on the radio's front panel. *Only* these antennas may be used. The WiFi module can operate as an 802.11 Access Point or Infrastructure Station, according to user configuration. The operational mode (**AP, Infrastructure RM**) and frequency can be configured through the unit's user interface.

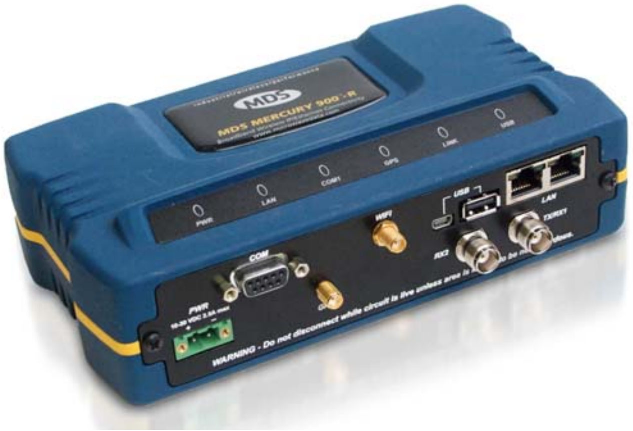

Figure 1-2. Mercury Remote with WiFi
(Note interface connector differences from Standard Remote)

802.11 WiFi Module Specifications

The specifications listed below are unique to Remotes with WiFi, which contain a 2.4 GHz wireless module. *SPECIFICATIONS* on Page 180 contains a complete list of general Mercury Series specifications.

Protocol:	IEEE 802.11b/g OFDM 6 to 54Mbps, CCK 1 to 11Mbps
Frequency Range:	2400 to 2500 MHz
Maximum Transmit Power:	18 dBm (Default is 15 dBm)
Permissible Antennas:	MDS 97-4278A36 MDS 97-4278A34 MDS 97-4278A35
FCC:	Part 15C
FCC ID:	VRA-SG9011028
WiFi Antenna Connector:	Female Reverse SMA

1.2.3 GE MDS P23 Protected Network (Redundant) Configuration

For mission-critical applications, a Protected Network Station is also offered. This unit incorporates two Access Points, two power supplies, and a switchover logic board that automatically selects between Transceiver A and Transceiver B as the active radio. Figure 1-3 shows the protected chassis. For system-level information on this product, refer to MDS publication 05-4161A01.

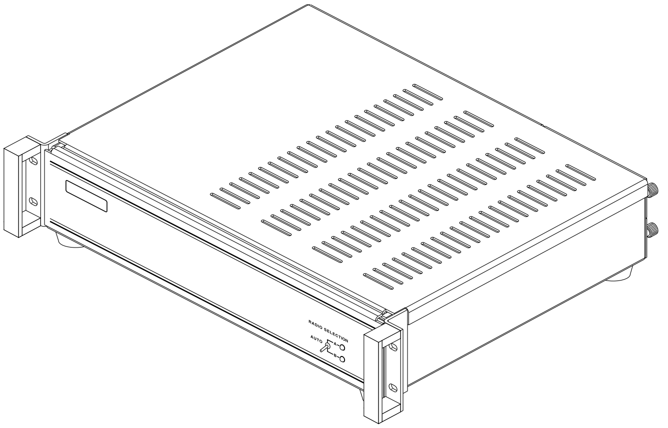

Figure 1-3. MDS P23 Protected Network Station
(incorporates two transceivers, with automatic switchover)

1.2.4 External GPS PPS Option

The External GPS Precise Positioning Service (PPS) option allows for an external GPS device to provide the PPS input to the Mercury. This is useful in installations where multiple radios require GPS timing. This option prevents each Mercury from requiring its own GPS antenna. Refer to the electrical specifications in the *External GPS PPS Option* section on Page 182. This option is only available in hardware revision 1.0.2 or later.

1.3 APPLICATIONS

The following sections provide illustrations of typical transceiver installations. This is an overview only. A Network Administrator should be involved in all installation planning activities.

1.3.1 Mobile/Fixed Data System

Mercury transceivers support high-speed data communications in a mobile environment. In this application, Remote radios “roam” between different Access Points, providing seamless transitions and continuous coverage throughout a municipal area. Figure 1-4 shows an example of an integrated system employing both mobile and fixed Mercury transceivers.

NOTE: 3650 MHz is for APs and Fixed Remote stations only.

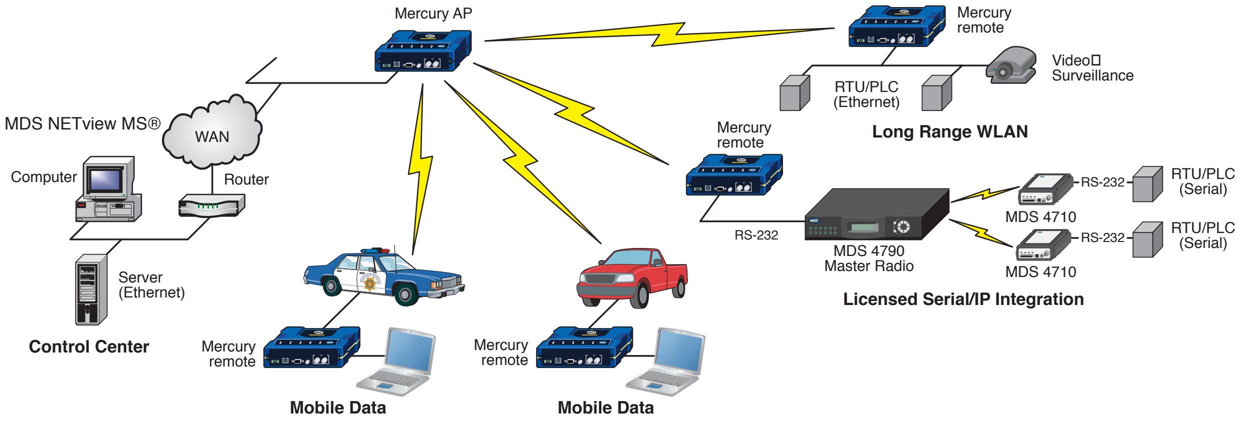

Figure 1-4. Integrated Mobile/Fixed Application

1.3.2 Wireless LAN

The wireless LAN is a common application of the transceiver. It consists of a central control station (Access Point) and one or more associated Remote units, as shown in Figure 1-5. A LAN provides communications between a central WAN/LAN and remote Ethernet segments. The operation of the radio system is transparent to the computer equipment connected to the transceiver.

The Access Point is positioned at a location from which it communicates with all Remote units in the system. Commonly, this is a high location on top of a building or communications tower. Messages are exchanged at the Ethernet level. This includes all types of IP traffic.

A Remote transceiver can only communicate over-the-air to an Access Point (AP). Peer-to-peer communications between Remotes can only take place indirectly via the AP. In the same fashion, an AP can only communicate over-the-air to associated Remote units. Exception: Two APs can communicate with each other "off-the-air" through their Ethernet connectors using a common LAN/WAN.

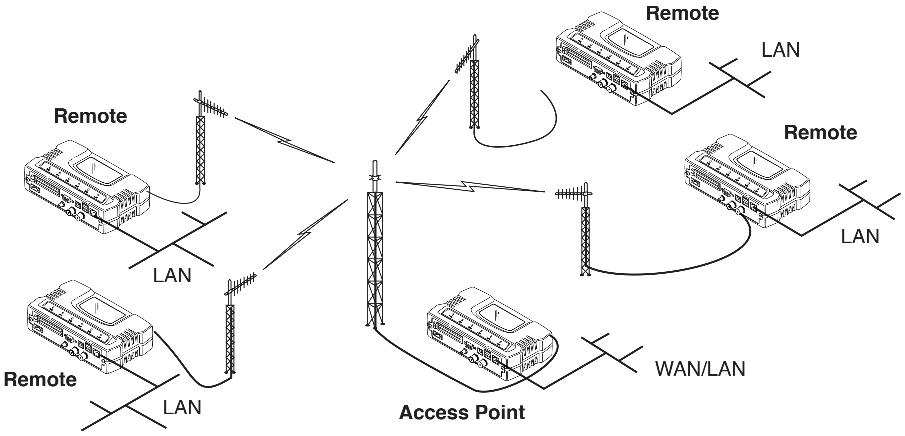

Figure 1-5. Typical Wireless LAN

1.3.3 Point-to-Point LAN Extension

A point-to-point configuration (Figure 1-6) is a simple arrangement consisting of an Access Point and a Remote unit. This provides a communications link for transferring data between two locations.

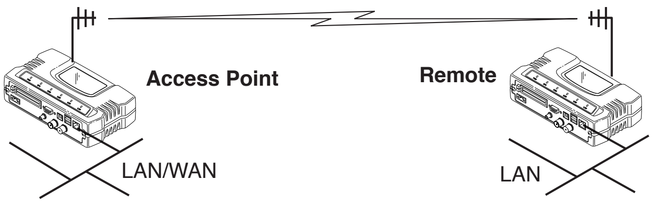

Figure 1-6. Typical Point-to-Point Link

1.3.4 Serial Radio Network Connectivity

The transceiver provides a path for serial devices to migrate to IP/Ethernet systems. Many radio networks in operation today still rely on serial networks at data rates of 9600 bps or less. These networks can use the transceiver as a means to continue using the serial service, while allowing the infrastructure to migrate to an IP format.

A Remote transceiver with its serial port connected to a GE MDS serial-based radio, such as the MDS x790/x710, MDS TransNET and others, provides a path for bringing the data from the older radio into the IP/Ethernet environment of a Mercury-based system.

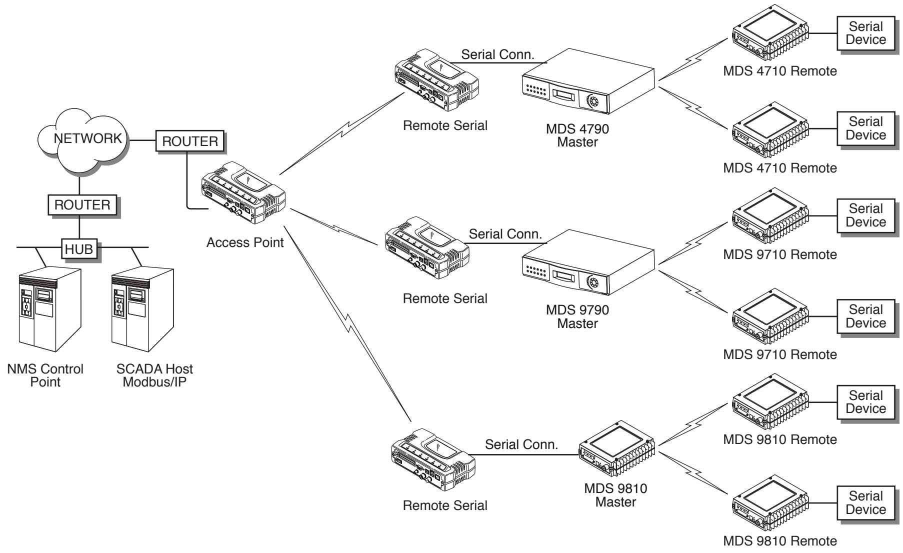

Figure 1-7. Backhaul Network

1.3.5 Multiple Protocols and/or Services

Prior to the introduction of Ethernet/IP-based radios, two radios were often used to service two different types of devices (typically connected to different SCADA hosts). A Mercury radio provides this capability using a single remote unit. The unit's serial port can be connected via IP to different SCADA hosts, transporting different (or the same) protocols. Both data streams are completely independent, and the transceiver provides seamless simultaneous operation as shown in Figure 1-8.

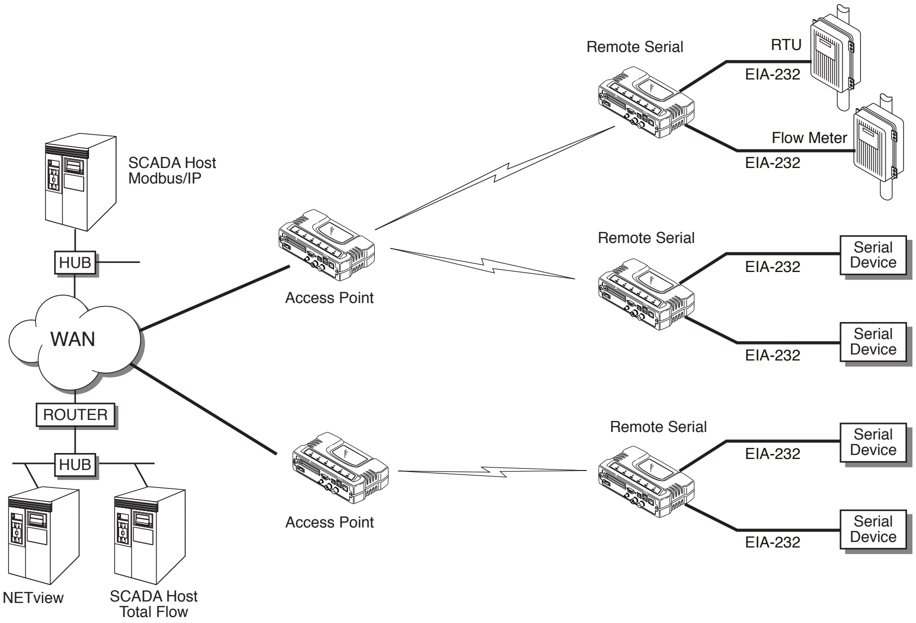

Figure 1-8. Multiple Protocol Network

By using a single radio, the cost of deployment is cut in half. Beyond requiring only one radio instead of two, the biggest cost reduction comes from using half of the required infrastructure at the remote site: one antenna, one feedline, one lightning protector and ancillary hardware. Other cost reductions come from the system as a whole, such as reduced management requirements. And above all, the radio provides the potential for future applications that run over Ethernet and IP, such as video for remote surveillance.

1.3.6 Wireless LAN with Mixed Services

The transceiver is an excellent solution for a long-range industrial wireless LAN. It offers several advantages over commercial solutions, primarily improved performance over extended distances. The rugged construction of the radio and its extended temperature range make it an ideal solution even in harsh locations. In extreme environments, a simple NEMA enclosure is sufficient to house the unit.

The transceiver trades higher speed for longer range. Commercial 802.11a/b/g solutions are designed to provide service to relatively small areas such as offices, warehouses and homes. They provide high data rates but have limited range. The Mercury transmits at a higher power level, uses a different frequency band, has higher sensitivity, and a narrower channel to concentrate the radio energy, reaching farther distances. It is designed for industrial operation from the ground up.

IP-based devices that may be used with the transceiver include new, powerful Remote Terminal Units (RTUs) and Programmable Logic Controllers (PLCs). These, as well as other devices, may be used in applications ranging from SCADA/telemetry monitoring, web-based video, security monitoring, and Voice over IP. Figure 1-9 shows a typical wireless IP network.

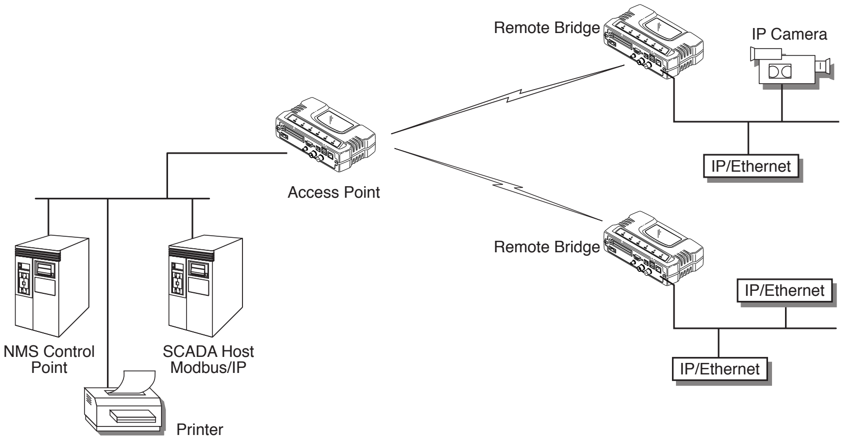

Figure 1-9. Extended-Range LAN with Mixed Applications

1.3.7 Upgrading Older Wireless Network with Serial Interfaces

Millions of wireless data products have been installed in the last two decades for licensed and license-free operation, many of them manufactured by GE MDS. There are several ways that these systems can benefit from incorporating Mercury equipment. The chief advantages are interface flexibility (serial and Ethernet in one unit), and higher data throughput. By taking advantage of its built-in serial and Ethernet interfaces, the transceiver is well suited to replace leased lines, dial-up lines, or existing “multiple address” data transceivers.

Replacing Legacy Wireless Products

In most cases, legacy radio transceivers supporting serial-interface equipment can be replaced with Mercury transceivers. Legacy equipment can be connected to the transceiver through the COM1 port with a DB-25 to DB-9 cable wired for EIA-232 signaling. The COM1 port acts as a Data Communications Equipment (DCE) port.

NOTE: Several previous GE MDS-brand products had non-standard signal lines on their interface connectors (for example, to control sleep functions and alarm lines). These special functions are not provided nor supported by the Mercury transceiver. Consult equipment manuals for complete pinout information.

1.4 NETWORK DESIGN CONSIDERATIONS

1.4.1 Extending Network Coverage with Repeaters

What is a Repeater System?

A repeater works by re-transmitting data from outlying remote sites to the Access Point, and vice-versa. It introduces some additional end-to-end transmission delay but provides longer-range connectivity.

In some geographical areas, obstacles can make communications difficult. These obstacles are commonly large buildings, hills, or dense foliage. These obstacles can often be overcome with a repeater station.

Option A—Using two transceivers to form a repeater station (back-to-back repeater)

Although the range between fixed transceivers can be up to 40 km (25 miles) over favorable terrain, it is possible to extend the range considerably by connecting two units together at one site in a "back-to-back" fashion, creating repeater as shown in Figure 1-10. Use this arrangement whenever the objective is to utilize the maximum range between stations. In this case, using high-gain Yagi antennas at each location provides more reliable communications than their counterparts—omnidirectional antennas.

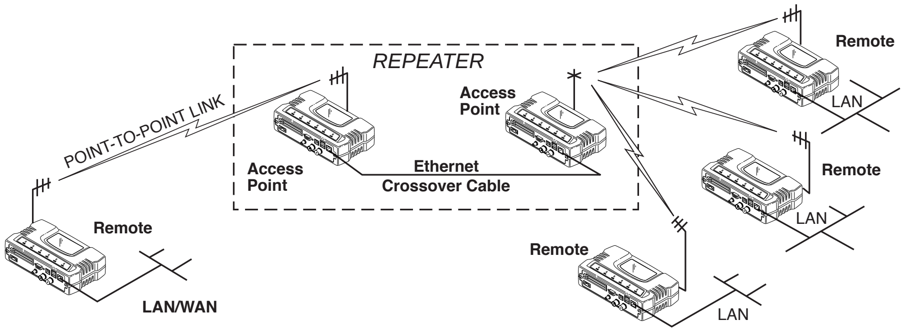

Figure 1-10. Typical LAN with a Repeater Link

Overview

Two transceivers may be connected "back-to-back" through the LAN ports to form a repeater station. If the transceivers are connected directly to each other, you must use an Ethernet cross-over cable. This configuration is sometimes required in a network that includes a distant Remote that would otherwise be unable to communicate directly with the Access Point station due to distance or terrain.

The geographic location of a repeater station is especially important. Choose a site that allows good communication with *both* the Access Point and the outlying Remote site. This is often on top of a hill, building, or other elevated terrain from which both sites can be "seen" by the repeater station antennas. A detailed discussion on the effects of terrain is given in Section 5.1.2, *Site Selection* (beginning on Page 167).

The following paragraphs contain specific requirements for repeater systems.

Antennas

Two antennas are required at this type of repeater station—one for each radio. You must take measures to minimize the chance of interference between these antennas. One effective technique for limiting interference is to employ *vertical separation*. In this arrangement, assuming both antennas are vertically polarized, one antenna is mounted *directly* over the other, separated by at least 10 feet (3 meters). This takes advantage of the minimal radiation exhibited by most antennas directly above and below their driven elements.

Another interference reduction technique is to cross-polarize the repeater antennas. If one antenna is mounted for polarization in the vertical plane, and the other in the horizontal plane, an additional 20 dB of attenuation is achieved. The corresponding stations should use the same antenna orientation when cross-polarization is used.

Network Name

The two radios that are wired together at the repeater site *must* have different network names. For information on how to set or view the network names, see *"STEP 3: CONNECT PC TO THE TRANSCEIVER"* on Page 25.

TDD Sync Mode

To avoid interference between the two APs that form a repeater station, they should be synchronized so that they will transmit at the same time and receive at the same time. This eliminates the possibility of one AP transmitting while another is trying to receive.

This can be accomplished by setting the **TDD Sync Mode** parameter in the **Frequency Configuration** menu to **GPS Required**. See *Frequency Control Menu* on Page 69 for details.

Option B—Using the AP as a Store-and-Forward Packet Repeater

You can extend a wireless network by using the Access Point as a repeater to re-transmit the signals of all stations in the network. (See Figure 1-11 on Page 16.)

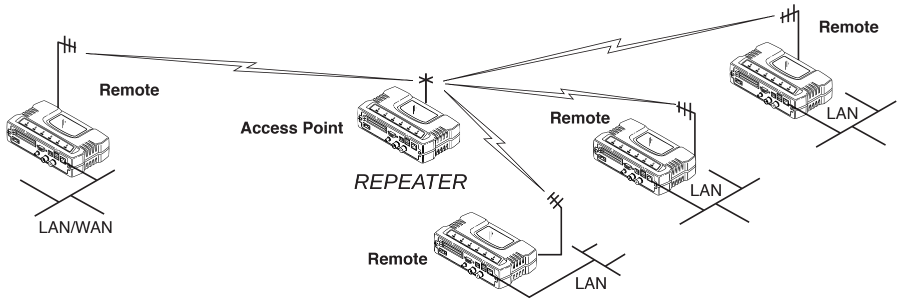

Figure 1-11. Typical Store-and-Forward Repeater Arrangement

As with the conventional repeater described in Option 1 above, the location of a store and forward repeater is also important. A site must be chosen that allows good communication with *both* the Access Point and the outlying Remote site. This can be on the top of a hill, building, or other elevated terrain from which all sites can be "seen" by the repeater station antenna. A detailed discussion on the effects of terrain is given in Section 5.1.2, *Site Selection* (beginning on Page 167).

1.4.2 Protected Network Operation using Multiple APs

Although GE MDS transceivers have a very robust design and have undergone intensive testing before being shipped, it is possible for isolated failures to occur. In mission-critical applications, down time can be virtually eliminated by using some, or all, of the following configurations:

In a point-to-multipoint scenario, the Access Point services multiple remotes. A problem in the Access Point will have an effect on all remotes, since none will have access to the network. When operation of the network does not tolerate any down time, it is possible to set up a protected configuration for the Access Point to greatly reduce the possibility of this occurrence.

Two or more Access Points can be configured identically, each with its own independent antenna. In this scenario, Remotes will associate with one of the available Access Points. In case of a failure of that AP, the Remotes will quickly associate with another Access Point, re-establishing connectivity to the end devices. Because only one Access Point operates at any given time, collisions between APs is not possible.

1.4.3 Collocating Multiple Radio Networks

Many networks can operate in relatively close physical proximity to one another provided reasonable measures are taken to assure the radio signal of one Access Point is not directed at the antenna of the second Access Point**.**

The Network Name and the Association Process

The Network Name is the foundation for building individual radio networks. Remotes in a network with the same network name as an Access Point (AP) unit are “associated” with that AP.

The use of a different Network Name does not guarantee an interference-free system. It does, however, assure that only data destined for a unique network is passed through to that network.

Co-Location for Multiple Networks

It may be desirable to co-locate Access Points at one location to take advantage of an excellent location that can serve two independent networks. Configure each network with a unique Network Name, and install each AP’s antenna with at least 10 feet of vertical separation to minimize RFI.

To co-locate APs, configure them with Time Division Duplex (TDD) Sync set to **GPS Required**. Configure all APs that are within range of each other with the same pattern, but with a unique Hop Pattern Offset. For more information, see *“Frequency Control Menu”* on Page 69.

NOTE: Transceivers are shipped with the Network Name set to **MDS-Mercury** as a factory default.

Can radio frequency interference (RFI) disrupt my wireless network?

When multiple radio networks operate in close physical proximity to other wireless networks, individual units may not operate reliably under weak signal conditions and may be influenced by strong radio signals on adjacent bands. This radio frequency interference cannot be predicted with certainty, and can only be determined by experimentation. If you need to co-locate two units, start by using the largest possible vertical antenna separation between the two AP antennas on the same support structure. If that does not work, consult with your factory representative about other techniques for controlling radio frequency interference between the radios. (See *“A Word About Radio Interference”* on Page 171 for more details.)

1.5 GE MDS CYBER SECURITY SUITE

Today, the operation and management of an enterprise is increasingly dependent on electronic information flow. An accompanying concern becomes the cyber security of the communication infrastructure and the security of the data itself.

The transceiver is capable of dealing with many common security issues. Table 1-2 profiles security risks and how the transceiver provides a solution for minimizing vulnerability.

Table 1-2. Security Risk Management

Security Vulnerability	GE MDS Cyber Security Solution
Unauthorized access to the backbone network through a foreign remote radio	• IEEE 802.1x device authentication • Approved Remotes List (local) Only those remotes included in the AP list will associate
“Rogue” AP, where a foreign AP takes control of some or all remote radios and thus remote devices	• IEEE 802.1x device authentication • Approved AP List A remote will only associate to those APs included in its local authorized list of APs
Dictionary attacks, where a hacker runs a program that sequentially tries to break a password.	• Failed-login lockdown After five tries, the transceiver ignores login requests for 5 minutes. Critical event reports (traps) are generated as well.
Denial of service, where Remote radios could be reconfigured with bad parameters, bringing the network down.	• Remote login with SSH or HTTPS • Local console login • Disabled HTTP and Telnet to allow only local management services
Airsnort and other war-driving hackers in parking lots, etc.	• Main transceiver operation is not interoperable with standard 802.11 wireless cards (WiFi function is 802.11 compatible). • The transceiver cannot be put in a promiscuous mode • Proprietary data framing
Eavesdropping, intercepting messages	• AES-128 encryption
Unprotected access to configuration via SNMPv1	• Implement SNMPv3 secure operation
Intrusion detection	• Provides early warning via SNMP through critical event reports (unauthorized, logging attempts, etc.) • Unauthorized AP MAC address detected at Remote • Unauthorized Remote MAC address detected at AP • Login attempt limit exceeded (Accessed via: Telnet, HTTP, or local) • Successful login/logout (Accessed via: Telnet, HTTP, or local)

1.6 ACCESSORIES

Table 1-3 lists common accessories and spare items for the transceiver. GE MDS also offers an *Accessories Selection Guide* listing an array of additional items that may be used with the product. Contact your factory representative or visit **www.GEmds.com** to obtain a copy of the guide.

Table 1-3. Accessories

Accessory	Description	GE MDS Part No.
AC Power Adapter Kit	A small power supply module designed for continuous service. UL approved. Input: 120/220; Output: 13.8 Vdc @ 2.5 A	01-3682A02
Omni-Directional Antennas	Rugged antennas well suited for use at Access Point installations. Consult with your factory Sales Representative for details	--
Yagi Antenna (Directional)	Rugged antennas well suited for use at fixed Remote sites. Consult with your factory Sales Representative for details.	--
GPS Receiving Antennas	A variety of fixed and mobile GPS antennas (active and passive) are available. Consult with your factory Sales Representative for details.	--
TNC Male-to-N Female Adapter	One-piece RF adaptor plug.	97-1677A161
TNC Male-to-N Female Adapter Cable	Short length of coaxial cable used to connect the radio's TNC antenna connector to a Type N commonly used on large diameter coaxial cables.	97-1677A159 (3 ft./1m) 97-1677A160 (6 ft./1.8m)
Ethernet RJ-45 Crossover Cable (CAT5)	Cable assembly used to cross-connect the Ethernet ports of two transceivers used in a repeater configuration. (Cable length ≈ 3 ft./1M)	97-1870A21
2-Pin Power Plug	Mates with power connector on transceiver. Screw terminals provided for wires, threaded locking screws to prevent accidental disconnect.	73-1194A39
Ethernet RJ-45 Straight-thru Cable (CAT5)	Cable assembly used to connect an Ethernet device to the transceiver. Both ends of the cable are wired identically. (Cable length ≈ 3 ft./1M)	97-1870A20
EIA-232 Shielded Data Cable	Shielded cable terminated with a DB-25 male connector on one end, and a DB-9 female on the other end. Two lengths available (see part numbers at right).	97-3035L06 (6 ft./1.8m) 97-3035L15 (15 ft./4.6m)
EIA-232 Shielded Data Cable	Shielded cable terminated with a DB-9 male connector on one end, and a DB-9 female on the other end, 6 ft./1.8m long.	97-1971A03
Flat-Surface Mounting Brackets & Screws	Brackets: 2″ x 3″ plates designed to be screwed onto the bottom of the unit for surface-mounting the radio.	82-1753-A01
	Bracket screws: 6-32/1/4″ with locking adhesive. (Industry Standard MS 51957-26)	70-2620-A01
Fuse	Internal fuse, 5.0 Ampere	29-1784A04

Table 1-3. Accessories *(Continued)*

Accessory	Description	GE MDS Part No.
DIN Rail Mounting Bracket	Bracket used to mount the transceiver to standard 35 mm DIN rails commonly found in equipment cabinets and panels.	03-4022A03
COM1 Interface Adapter	DB-25(F) to DB-9(M) shielded cable assembly (6 ft./1.8 m) for connection of equipment or other EIA-232 serial devices previously connected to “legacy” units. (Consult factory for other lengths and variations.)	97-3035A06
Bandpass Filter	Antenna system filter that helps eliminate interference from nearby paging transmitters.	20-2822A02
Ethernet Surge Suppressor	Surge suppressor for protection of Ethernet port against lightning.	29-4018A01

2 TABLETOP EVALUATION AND TEST SETUP

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2.1 OVERVIEW

GE MDS recommends that you set up a “tabletop network” to verify the basic operation of the transceivers. This allows experimenting with network designs, configurations, or network equipment in a convenient location. This test can be performed with any number of radios.

When you are satisfied that the network is functioning properly in a benchtop setting, perform the field installation. Complete information for field installation, including mounting dimensions and antenna selection, is provided in *INSTALLATION PLANNING* on Page 165.

NOTE: It is important to use a “Network Name” that is different from any currently in use in your area during the testing period.

To simulate data traffic over the radio network, connect a PC or LAN to the Ethernet port of the Access Point and PING *each* transceiver several times.

2.2 STEP 1: CONNECT THE ANTENNA PORTS

Figure 2-1 shows the tabletop arrangement. Connect the antenna ports of each transceiver as shown. This provides stable radio communications between each unit and prevents interference to nearby electronic equipment.

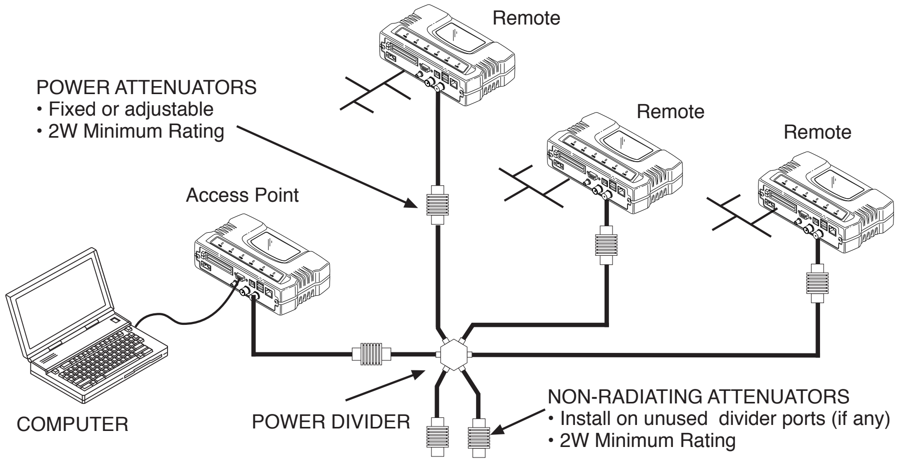

Figure 2-1. Typical Setup for Tabletop-Testing of Radios

NOTE: Use attenuation between all units in the test setup. The amount of attenuation required depends on the number of units tested and the desired signal strength (RSSI) at each transceiver during the test. In no case should a signal greater than –50 dBm be applied to any transceiver in the test setup. GE MDS recommends an RF power output level of +20 dBm from the AP. Remote power is not setable. (See *“Radio Configuration Menu”* on Page 67.)

2.3 STEP 2: CONNECT THE PRIMARY POWER

The primary power at the transceiver’s power connector must be within 10.5–30 Vdc and be capable of continuously providing 30 Watts. Typical power consumption for 13.8 Vdc and 24 Vdc operation are listed in *SPECIFICATIONS* on Page 180.

A Phoenix two-pole power connector with screw-terminals is provided with each unit. Strip the wire leads to 6 mm (0.25"). Be sure to observe proper polarity with the positive lead (**+**) on the left and negative (**–**) on the right, as shown in Figure 2-2.

NOTE: The transceiver typically requires about 30 seconds to power up, and might require several minutes to associate with another unit, if GPS is required for time synchronization.

GPS is required for all configurations except when “Free Run” single-channel (non-frequency hopping) operation is used, which might be possible in some low-interference environments.

CAUTION
POSSIBLE
EQUIPMENT
DAMAGE

Only use the transceiver with negative-ground power systems. Make sure the polarity of the power source is correct.

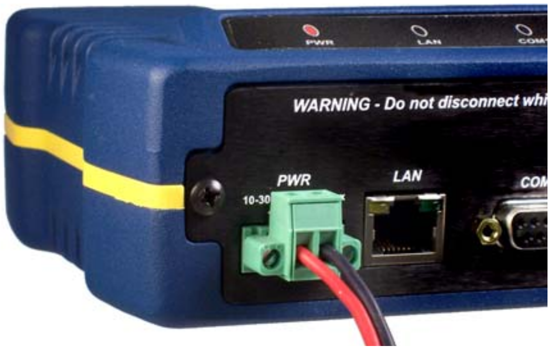

Figure 2-2. **Power Connector (Polarity: Left +, Right —)**

2.4 STEP 3: CONNECT PC TO THE TRANSCEIVER

Connect a PC's Ethernet port to the LAN port using an Ethernet cross-over cable. The LAN LED should light. Alternatively, you can use a serial cable to connect to the COM1 port (Figure 2-3 on Page 27).

2.5 STEP 4: REVIEW TRANSCEIVER CONFIGURATION

NOTE: The steps given here are intended to set the *basic* configuration of radios. There are many additional settings that may be tailored to optimize performance in specific application scenarios. For recommended in-service settings, refer to *PERFORMANCE OPTIMIZATION* on Page 142.

2.5.1 Getting Started

Start by logging into the Access Point radio. This is done first because the Remotes are dependent on the AP's beacon signal to achieve an "associated" state.

Once the Access Point is up and running, move the computer connection to each of the Remote units, log-in at each unit, review their configuration, set their IP addresses, Network Name, and frequency configuration, then wait for each AP to achieve an associated state.

With all units associated, you will be ready to connect and test your data services.

2.5.2 Procedure

The following is a summary of the configuration procedure that must be done on each unit in the system. Key parameters are shown on the Embedded Management System overview (Figure 3-1 on Page 34). A lists of parameters is located in two tables—Table 4-5 on Page 156 and Table 4-7 on Page 158. Detailed information on using the Management System can be found in *INTRODUCTION* on Page 33.

NOTE: The Management System supports the use of "configuration files" to help consistently configure multiple units. These are explained in *Configuration Scripts Menu* on Page 133.

2.5.3 Basic Configuration Defaults

Table 2-1 provides a selection of key operating parameters, their range, and default values. All of these are accessible through a terminal emulator connected to the COM1 serial port or through a Web browser connected to the LAN port (see Figure 5-1 on Page 165 for hookup).

NOTE: Access to the transceiver's Management System and changes to all parameters requires entering a security password.

Table 2-1. Basic Configuration Defaults

Item	Menu Location	Default	Values/Range
Network Name	Main Menu>> Radio Configuration>> Network Name	MDS-Mercury	• 1–15 alphanumeric characters • Case-sensitive; can be mixed case
IP Address	Main Menu>> Network Configuration>> IP Address	192.168.1.1	Contact your network administrator
RF Output Power	Main Menu>> Radio Configuration>> Transmit Power	+29 dBm (900 model) +23 dBm (3650 model)	AP: -30 to +29 dBm RM: 0 to +29 dBm
Unit Password	Main Menu>> Device Information>> User Password	admin (lower case)	• 1–13 alphanumeric characters • Case-sensitive; can be mixed case

For benchtop evaluation, configure:

- **Frequency Mode** = Single Channel
- **Single Frequency Channel** = 0
- **RF Bandwidth** = 1.75
- **TDD Sync** = Free Run

For more information on configuring these parameters, see *"Frequency Control Menu"* on Page 69.

A unique IP address and subnet are required to access all IP-based management interfaces (telnet, SSH, SNMP, and Web), either through the LAN port or remotely over-the-air.

2.6 STEP 5: CONNECT LAN OR SERIAL DATA EQUIPMENT

Connect a local area network to the LAN port or a serial device to the COM1 (DCE) port. The LAN port supports any Ethernet-compatible equipment. This includes devices that use Internet Protocol (IP).

Figure 2-3 on Page 27 shows the interface connectors on the front panel of the standard transceiver (Remote). The Remote with WiFi connectors are shown in Figure 2-4 on Page 28.

NOTE: The use of shielded Ethernet cable is recommended for connection to the radio's ETH port. The radio meets regulatory emission standards without shielded cable, but shielding reduces the possibility of interference in sensitive environments, and is in keeping with good engineering practice.

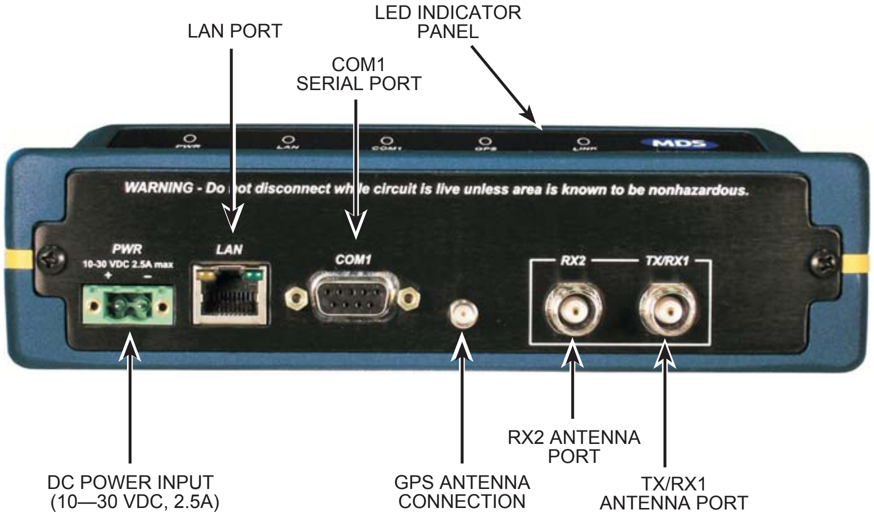

Figure 2-3. Transceiver Interface Connectors
(Standard unit shown; See Figure 2-4 on Page 28 for Remote w/WiFi)

- **LED INDICATOR PANEL**—Displays the basic operating status of the transceiver. See section 2.7 on Page 29 for detailed information.
- **COM1 SERIAL PORT**— DB-9 connector used for management of the transceiver with a connected PC. *INTRODUCTION* on Page 33 provides complete connection details.
- **LAN PORT**—Connection point for Ethernet Local Area Network. The connector has integrated LEDs to indicate signal activity as follows: A steady green LED indicates that a link has been achieved; a flashing green LED indicates data activity; and a yellow LED indicates 100 Mbps operation.
- **PWR**— DC power connection for the transceiver. Power source must be 10 Vdc to 30 Vdc, negative ground, and capable of providing at least 25 watts.
- **GPS ANTENNA PORT**— Coaxial connector (SMA-type) for connection of a GPS receiving antenna. Provides 3.5 Vdc output for compatibility with powered (active) GPS antennas. The GPS receiving antenna's gain must be 16 dBi or less.

NOTE: GPS functionality is required on all Access Points and Remotes except when "Free Run" single-channel (non-frequency hopping) operation is used, which might be possible in some low-interference environments.

- **RX2 ANTENNA PORT**— Coaxial connector (TNC-type) for attachment of a second receiving antenna used in space diversity arrangements.

- **TX/RX1 ANTENNA PORT**— Coaxial connector (TNC-type) for attachment of the main station antenna (transmit and receive).

2.6.1 Remote with WiFi Connectors

Figure 2-4 shows the interface connectors on the front panel of a Remote with WiFi.

NOTE: The use of shielded Ethernet cable is recommended for connection to the radio's ETH port. The radio meets regulatory emission standards without shielded cable, but shielding reduces the possibility of interference in sensitive environments, and is in keeping with good engineering practice.

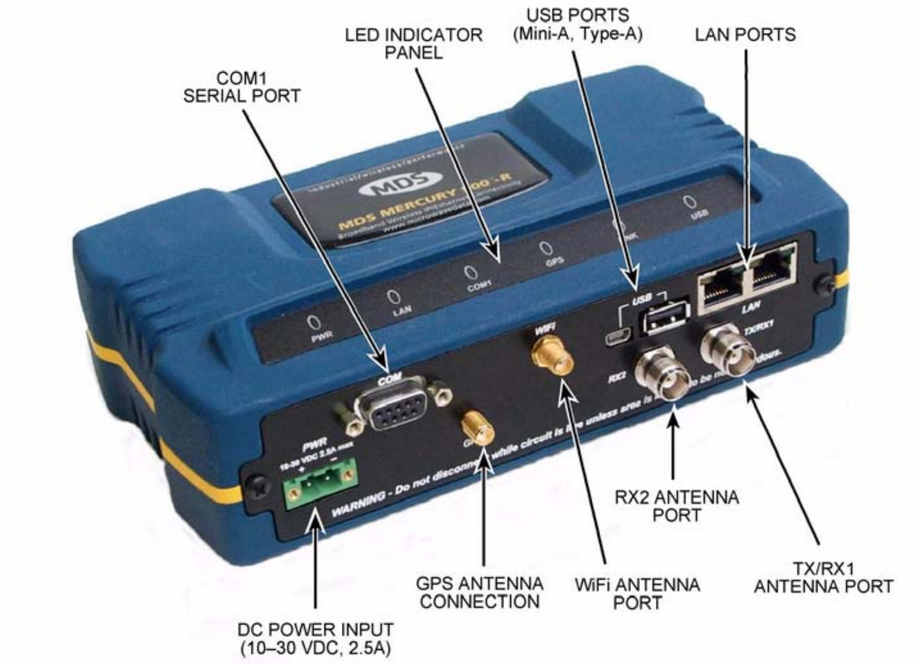

Figure 2-4. Transceiver Interface Connectors (with WiFi)

- **LED INDICATOR PANEL**—Displays the basic operating status of the transceiver. See section 2.7 on Page 29 for detailed information.
- **COM1 SERIAL PORT**— DB-9 connector used for management of the transceiver with a connected PC. *INTRODUCTION* on Page 33 provides complete connection details.
- **LAN PORTS**—Connection point for Ethernet Local Area Network. The connectors have integrated LEDs to indicate signal activity as follows: A steady green LED indicates that a link has been achieved; a flashing green LED indicates data activity; and a yellow LED indicates 100 Mbps operation.

- **PWR**— DC power connection for the transceiver. Power source must be 10 Vdc to 30 Vdc, negative ground, and capable of providing at least 25 watts.
- **GPS ANTENNA PORT**— Coaxial connector (SMA-type) for connection of a GPS receiving antenna. Provides 3.5 Vdc output for compatibility with powered (active) GPS antennas. Do not short this connector, as you might cause damage to the internal power supply. The GPS receiving antenna's gain must be 16 dBi or less.

NOTE: GPS functionality is required on all Access Points and Remotes except when "Free Run" single-channel (non-frequency hopping) operation is used, which might be possible in some low-interference environments.

- **WiFi ANTENNA PORT**— Coaxial connector (SMA-type) for attachment of a WiFi antenna. WiFI is typically used for short range wireless communication at the transceiver site or within a small area around the site.
- **RX2 ANTENNA PORT**— Coaxial connector (TNC-type) for attachment of a second receiving antenna used in space diversity arrangements.
- **TX/RX1 ANTENNA PORT**— Coaxial connector (TNC-type) for attachment of the main station antenna (transmit and receive).

2.7 STEP 6: CHECK FOR NORMAL OPERATION

Once the data equipment is connected, you can check the transceiver for normal operation.

Observe the LEDs on the top cover for the proper indications. In a normally operating system, you will see the following LED indications within 45 seconds of start-up:

- PWR—Lit continuously
- LINK—On, or blinking intermittently to indicate traffic flow
- LAN—On, or blinking intermittently to indicate traffic flow

Figure 2-5 shows a close-up view of the transceiver's LED Indicator panel. Table 2-2 provides details on each LED function.

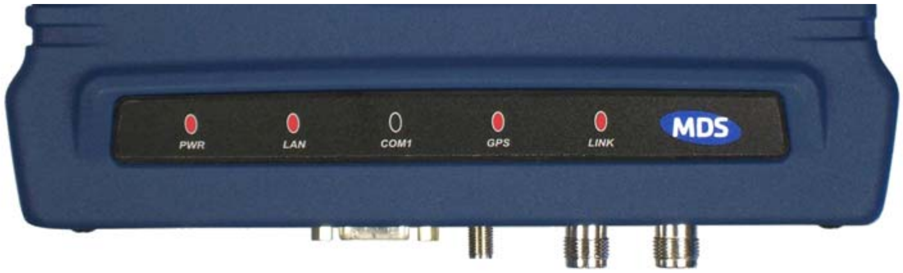

Figure 2-5. LED Indicator Panel

If the radio network seems to be operating properly based on observation of the unit's LEDs, use the **PING** command to verify the link integrity with the Access Point.

Table 2-2. Transceiver LED Functions

LED Label	Activity	Indication
PWR	ON	Primary power (DC) present
	Blinking	Unit in “Alarmed” state
	OFF	Primary power (DC) absent
LAN*	ON	LAN detected
	Blinking	Data TX/RX
	OFF	LAN not detected, or excessive traffic present
COM1 (MGT System)	Blinking	Data TX/RX
	OFF	No data activity
GPS	ON	Internal GPS receiver is synchronized with the satellite network.
	Blinking	AP modem is synchronizing with the GPS timing.
	OFF	Internal GPS receiver is not synchronized with the satellite network.
LINK (Access Point)	ON	Unit is operational
	OFF	Not transmitting. Usually occurs while waiting for GPS sync.
LINK (Remote)	ON	Associated to AP
	OFF	Not associated with AP
USB	ON	USB activity on either port
	OFF	No USB activity

* The LAN connector has two integrated LEDs to indicate signal activity as follows: A steady green LED indicates that a link has been achieved; a flashing green LED indicates data activity, and a yellow LED indicates 100 Mbps operation.

3 DEVICE MANAGEMENT

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3.1 INTRODUCTION

The transceiver's embedded management system is accessible through the COM1 (serial) port, the LAN (Ethernet) port, and using over-the-air Ethernet. Telnet, SSH, HTTP/HTTPS, and SNMP are the Ethernet-based interfaces. Essentially, the same capabilities are available through any of these paths.

For support of SNMP software, a set of MIB files is available for download from the GE MDS Web site at **www.GEmds.com**. An overview of SNMP commands can be found at *SNMP Agent Configuration* section on Page 60 of this manual.

The transceiver's Management System and its functions are divided into seven functional groups as listed below.

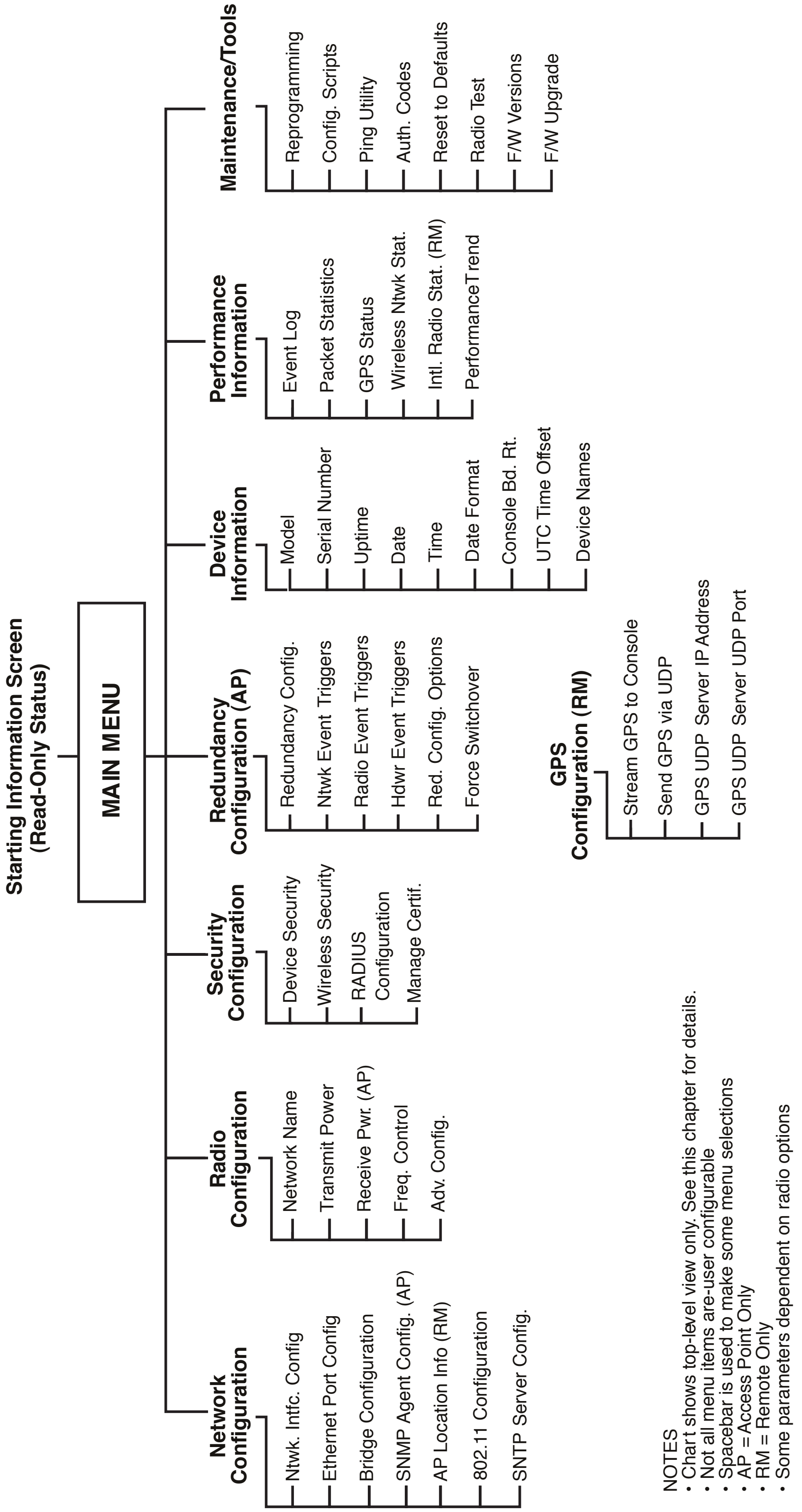
- Section 3.3, *BASIC OVERVIEW OF OPERATION* (beginning on Page 42)
- Section 3.4, *CONFIGURING NETWORK PARAMETERS* (beginning on Page 45)
- Section 3.5, *RADIO CONFIGURATION* (beginning on Page 67)
- Section 3.7, *SECURITY CONFIGURATION MENU* (beginning on Page 94)
- Section 3.13, *PERFORMANCE OPTIMIZATION* (beginning on Page 142)
- Section 3.12, *MAINTENANCE/TOOLS MENU* (beginning on Page 125)

Each of these sections has a focus that is reflected in its heading. The section you are now reading provides information on connecting to the Management System, how to navigate through it, how it is structured, and how to perform top-level configuration tasks. Figure 3-1 on Page 34 shows a top-level view of the Management System (MS).

NOTE: The radio's menu settings may be tailored to optimize performance in specific application scenarios. For recommended in-service settings, refer to *PERFORMANCE OPTIMIZATION* on Page 142.

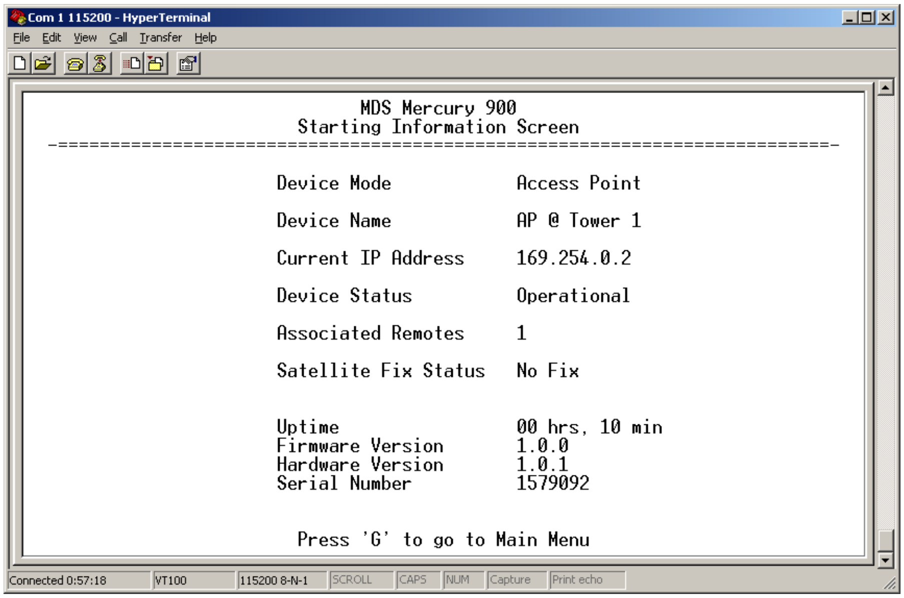
3.1.1 Differences in the User Interfaces

Although there are slight differences in navigation among the user interfaces, the content is very similar. You will notice a few differences in capabilities as the communications tool is driven by limitations of the access channel. Figure 3-2 and Figure 3-3 on Page 35 show examples of the Starting Information Screen as seen through a console terminal and a web-browser, respectively.



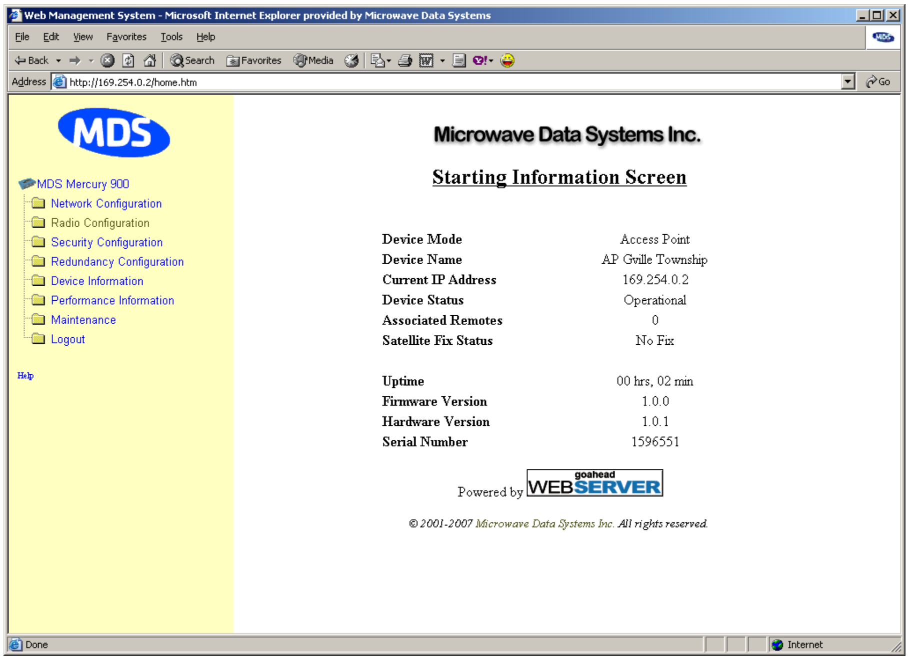
NOTES
- Char t shows top-level view only. See this chapter for details.
- Not all menu items are-user configurable
- Spacebar is used to make some menu selections
- AP = Access Point Only
- RM = Remote Only
- Some parameters dependent on radio options

Figure 3-1. Embedded Management System—Top-Level Flowchart



```
                    MDS Mercury 900
              Starting Information Screen
 -=========================================================================-

                      Device Mode          Access Point

                      Device Name          AP @ Tower 1

                      Current IP Address   169.254.0.2

                      Device Status        Operational

                      Associated Remotes   1

                      Satellite Fix Status No Fix


                      Uptime               00 hrs, 10 min
                      Firmware Version     1.0.0
                      Hardware Version     1.0.1
                      Serial Number        1579092


                Press 'G' to go to Main Menu
```

Figure 3-2. View of MS with a text-based program□
(Console Terminal shown□Telnet has similar appearance)



Microwave Data Systems Inc.

Starting Information Screen

Device Mode	Access Point
Device Name	AP Gville Township
Current IP Address	169.254.0.2
Device Status	Operational
Associated Remotes	0
Satellite Fix Status	No Fix
Uptime	00 hrs, 02 min
Firmware Version	1.0.0
Hardware Version	1.0.1
Serial Number	1596551

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Figure 3-3. View of the MS with a Browser
(Selections at left provide links to the various menus)

3.2 ACCESSING THE MENU SYSTEM

The radio has no external controls or adjustments. All configuration, diagnostics, and control is performed electronically using a connected PC. This section explains how to connect a PC, log into the unit, and gain access to the built-in menus.

3.2.1 Methods of Control

Access the unit's configuration menus in one of several ways:

- **Local Console**—*This is the primary method used for the examples in this manual*. Connect a PC directly to the COM1 port using a serial communications cable and launch a terminal communications program such as HyperTerminal (found on most PCs by selecting **Start>>Programs>>Accessories>>Communications>>HyperTerminal**). This method provides text-based access to the unit's menu screens. Console control is a hardware-based technique, and is intended for local use only (maximum recommended cable length of 50 ft./15 m).
- **Telnet or SSH***—Connect a PC to the unit's LAN port, either directly or via a network, and launch a Telnet session. This method provides text-based access to the unit's menu screens in a manner similar to a Local Console session. You can run Telnet sessions locally or remotely through an IP connection.
- **Web Browser***—Connect a PC to the unit's LAN port, either directly or via a network, and launch a web browser session (*for example,* Internet Explorer, Firefox, etc.). Enter the IP address of the device to be managed into the browser's address field.

  This method provides a graphical representation of each screen, just as you would see when viewing an Internet web site. The appearance of menu screens differs slightly from other methods of control, but the content and organization of screen items is similar. Web browser sessions may be run locally or remotely using an IP connection.

* When connecting directly to a radio, a *crossover* cable is required. When connecting using a network, switch, or router, a *straight-through* cable is required.

3.2.2 PC Connection and Log In Procedures

The following steps describe how to access the radio's menu system. These steps require a PC to be connected to the unit's COM1 or LAN port as shown in Figure 3-4 on Page 37.

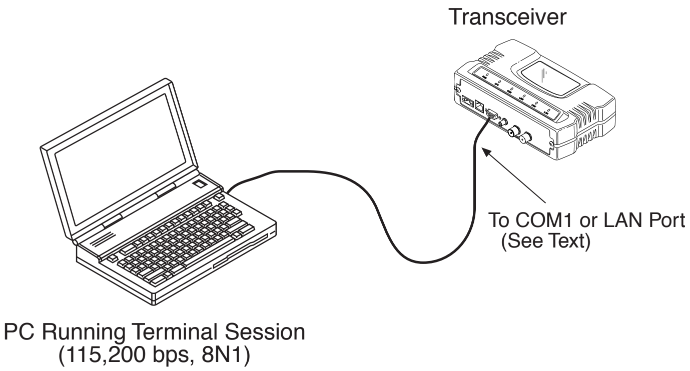


Figure 3-4. PC Configuration Setup

Starting a Local Console Session (Recommended for first-time log-in)

1. Connect a serial communications cable between the PC and the unit's COM1 port. If necessary, a cable may be constructed for this purpose as shown in Figure 3-5.

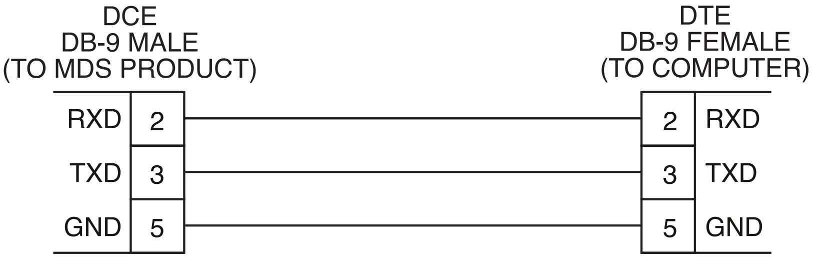


Figure 3-5. Serial Communications Cable (DB-9M to DB-9F)
(Maximum Recommended Cable Length 50 feet/15 meters)

2. Launch a terminal emulation program such as HyperTerminal and configure the program with the following settings:
   - 115,200 bps data rate
   - 8 data bits, no parity
   - One stop bit, and no flow-control
   - Use ANSI or VT100 emulation.

TIP: The HyperTerminal communications program can be accessed on most PCs by selecting this menu sequence: **Start>>Programs>>Accessories>>Communications>>HyperTerminal**.

NOTE: If the unit is powered-up or rebooted while connected to a terminal, you will see a series of pages of text information relating to the booting of the unit's processor. Wait for the log-in screen before proceeding.

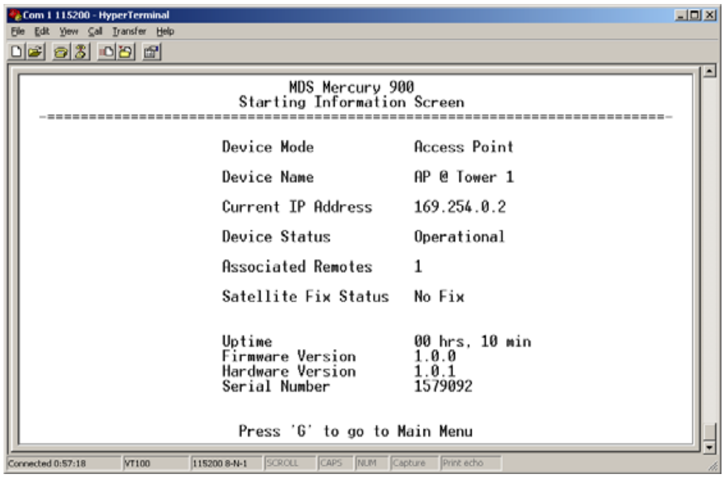
3. Press the ENTER key to receive the **login:** prompt.

4. Enter the username (default username is **admin**). Press ENTER.

5. Enter your password (default password is **admin**). For security, your password keystrokes do not appear on the screen. Press ENTER.

NOTE: Passwords are case sensitive. Do not use punctuation mark characters. You may use up to 13 alpha-numeric characters.

The unit responds with the Starting Information Screen (Figure 3-6). From here, you can review basic information about the unit or press **G** to proceed to the Main Menu.



```
                         MDS Mercury 900
                    Starting Information Screen
  -========================================================================-

                 Device Mode            Access Point

                 Device Name            AP @ Tower 1

                 Current IP Address     169.254.0.2

                 Device Status          Operational

                 Associated Remotes     1

                 Satellite Fix Status   No Fix


                 Uptime                 00 hrs, 10 min
                 Firmware Version       1.0.0
                 Hardware Version       1.0.1
                 Serial Number          1579092

                    Press 'G' to go to Main Menu
```

Figure 3-6. Starting Information Screen□Local Console Session

Starting a Telnet Session

NOTE: This method requires that you know the IP address of the unit beforehand. If you do not know the address, use the Local Console method (above) and access the Starting Information Screen. The address is displayed on this screen.

1. Connect a PC to the unit's LAN port, either directly with a *crossover cable* or via a network with a *straight-through* cable. The LAN LED lights to indicate an active connection.

NOTE: When using Ethernet to access the unit, you might need to change your computer's IP address to be on the same subnet as the radio. You can identify or verify the unit's IP address by using a Local Console session to communicate with the radio through its COM1 Port and viewing the Starting Information Screen.

2. Start the Telnet program on your computer, targeting the IP address of the unit to which you are connected, and press ENTER.

TIP: You can start a Telnet session on most PCs by selecting: **Start>>Programs>>Accessories>>Command Prompt**. At the command prompt window, type the word **telnet**, followed by the unit's IP address (*e.g.*, **telnet 10.1.1.168**). Press ENTER to receive the Telnet log in screen.

NOTE: Never connect multiple units to a network with the same IP address. Address conflicts will result in improper operation.

---

3. Enter your username (default username is **admin**). Press ENTER.

   Next, the **Password:** prompt appears. Enter your password (default password is **admin**). For security, your password keystrokes will not appear on the screen. Press ENTER.

   The unit responds with a Starting Information Screen (see Figure 3-6 on Page 38). From here, you can review basic information about the unit or press **G** to proceed to the Main Menu.

NOTE: Passwords are case sensitive. Do not use punctuation mark characters. You may use up to 13 alpha-numeric characters.

Starting a Web Browser Session

NOTE: Web access requires that you know the IP address of the unit you are connecting to. If you do not know the address, start a Local Console session (see *Starting a Local Console Session (Recommended for first-time log-in)* on Page 37) and access the Starting Information Screen. The IP address is displayed on this screen.

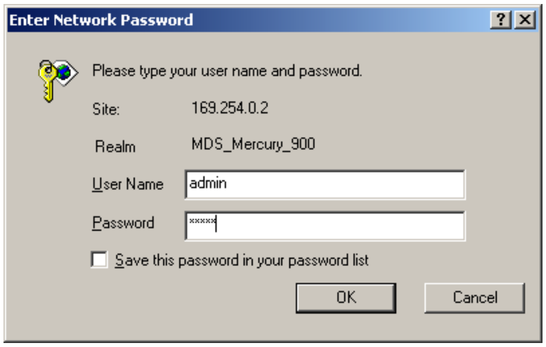
---

1. Connect a PC to the unit's LAN port, either directly or using a network. If connecting directly, use an Ethernet *crossover* cable; if connecting using a network, use a *straight-through* cable. The LAN LED lights to indicate an active connection.

2. Launch a Web-browser session on your computer (*i.e.,* Internet Explorer, Firefox, etc.).

3. Type the unit's IP address and press ENTER.

4. A log-in screen is displayed (Figure 3-7 on Page 40) where you enter a user name and password to access the unit's menu system. Note that the default entries are made in *lower case*. (Default User Name: **admin**; Default Password: **admin**)



Please type your user name and password.

Site: 169.254.0.2

Realm MDS_Mercury_900

User Name admin

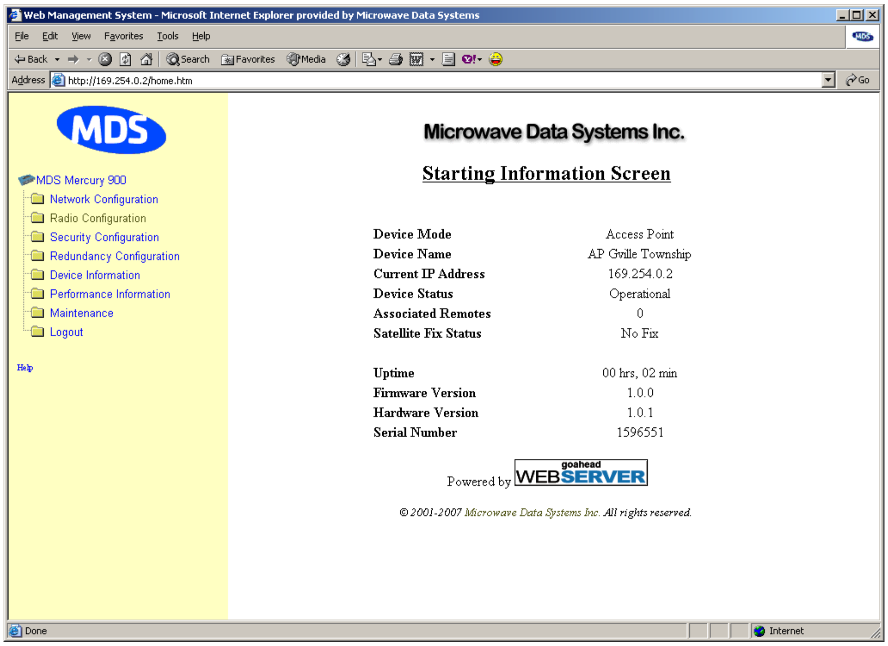
Password *****

□ Save this password in your password list

Figure 3-7. Log-in Screen when using a Web Browser

NOTE: Passwords are case sensitive. Do not use punctuation mark characters. You may use up to 13 alpha-numeric characters.

5. Click **OK**. The unit responds with a startup menu screen similar to that shown in Figure 3-8. From here, you can review basic information about the unit or click one of the menu items at the left side of the screen.


Web Management System - Microsoft Internet Explorer provided by Microwave Data Systems
File Edit View Favorites Tools Help
Back Search Favorites Media
Address http://169.254.0.2/home.htm
Go
MDS
MDS Mercury 900
Network Configuration
Radio Configuration
Security Configuration
Redundancy Configuration
Device Information
Performance Information
Maintenance
Logout
Help
Done
Internet

Microwave Data Systems Inc.

Starting Information Screen

Device Mode Access Point
Device Name AP Gville Township
Current IP Address 169.254.0.2
Device Status Operational
Associated Remotes 0
Satellite Fix Status No Fix

Uptime 00 hrs, 02 min
Firmware Version 1.0.0
Hardware Version 1.0.1
Serial Number 1596551

Powered by goahead WEBSERVER

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Figure 3-8. Starting Information Screen□Web Browser Example

3.2.3 Navigating the Menus

Via Terminal Telnet or SSH Sessions

Recommended for first-time log-in

Local Console, Telnet, and SSH sessions use multi-layered text menu systems that are nearly identical. To move further down a menu tree, you type the letter assigned to an item of interest. This takes you to an associated screen where settings may be viewed or changed. In most cases, pressing the ESCAPE key moves the screen back one level in the menu tree.

In general, the top portion of menu screens show *read-only* information (with no user selection letter). The bottom portion of the screen contains parameters you can select for further information, alteration of values, or to navigate to other submenus.

NOTE: Early versions of PuTTY might not operate when using SSH to connect to the transceiver. The latest version (0.60 at the time of publication) does work with the transceiver's internal server. Both the latest released and the latest development snapshot can be downloaded from: **www.chiark.greenend.org.uk/~sgtatham/putty/**.

When you arrive at a screen with user-controllable parameter fields, you select the menu item by pressing an associated letter on the keyboard. If there is a user definable value, the field will clear to the right of the menu item and you can type the value you wish to use. Follow this action by pressing the ENTER key to save the changes. If you make a mistake or change your mind before pressing the ENTER key, simply press ESCAPE to restore the previous value.

In some cases, when you type a letter to select a parameter, you will see a prompt at the bottom of the screen that says **Choose an Option**. In these screens, press the keyboard's SPACEBAR to step through the available selections. When the desired option appears, press the ENTER key to choose that selection. In some cases, you can change several parameters and then save them with a single keystroke. Use the ESCAPE key to cancel the action and restore the previous values.

Logging Out Via Terminal Emulator or Telnet

From the Main Menu screen, press **Q** to quit and terminate the session.

NOTE: To maintain security, it is best to log-out of the menu system entirely when you are done working with it. If you do not log out, the session automatically ends after 10 minutes of inactivity.

Navigating via Web Browser

Navigating with a Web browser is straightforward with a framed "home page." The primary navigation menu is permanently located on the left-hand side of this page. Simply click the desired menu item to make it active.

Logging Out Via Web Browser

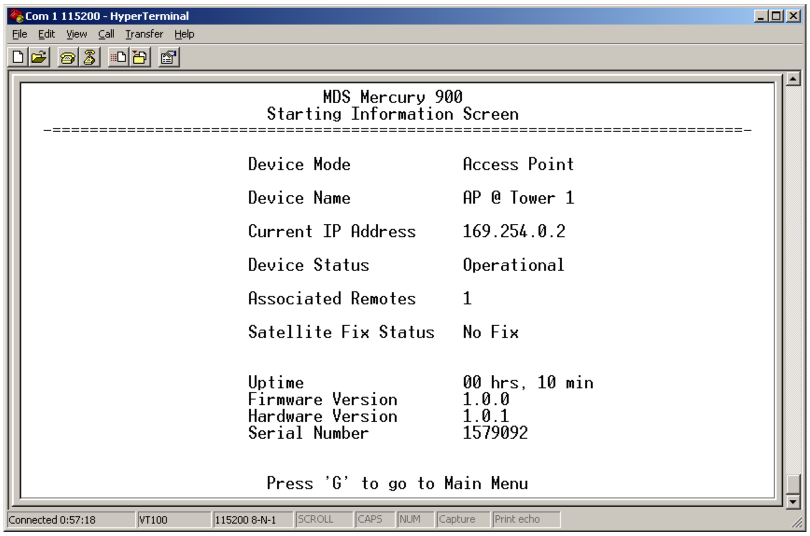
Click **Logout** in the left-hand frame of the browser window. The right-hand frame changes to a logout page. Follow the remaining instructions on this screen.

NOTE: In the menu descriptions that follow, parameter options/range, and any default values are displayed at the end of the text between square brackets. Note that the default setting is always shown after a semicolon:
[**available settings or range; default setting**]

3.3 BASIC OVERVIEW OF OPERATION

3.3.1 Starting Information Screen

Once you have logged into the Management System, the Starting Information Screen (Figure 3-9) appears with an overview of the transceiver and its current operating conditions.



```
                         MDS Mercury 900
                   Starting Information Screen
-==========================================================================-

                  Device Mode           Access Point

                  Device Name           AP @ Tower 1

                  Current IP Address    169.254.0.2

                  Device Status         Operational

                  Associated Remotes    1

                  Satellite Fix Status  No Fix


                  Uptime                00 hrs, 10 min
                  Firmware Version      1.0.0
                  Hardware Version      1.0.1
                  Serial Number         1579092


                    Press 'G' to go to Main Menu
```

Figure 3-9. Starting Information Screen
(AP screen shown; Remote similar, differences noted below)

- **Device Mode**—Operating mode of the unit as it relates to the radio network.
- **Device Name**—This is a user-defined parameter that appears in the heading of all pages. (To change it, see *Network Configuration Menu* on Page 45.)
- **Current IP Address**—Unit's IP address [**169.254.0.2**]
- **Device Status**—Condition of the unit's operation as follows:

  At Access Point:

  - **Operational**—Unit operating normally.
  - **Initializing**—This is the first phase after boot-up.
  - **Synchronizing**—Unit is waiting for the GPS receiver to obtain a satellite fix and for its internal clock to synchronize to the GPS timing signals.

- **Alarmed**—The unit has detected one or more alarms that have not been cleared.

At Remote:

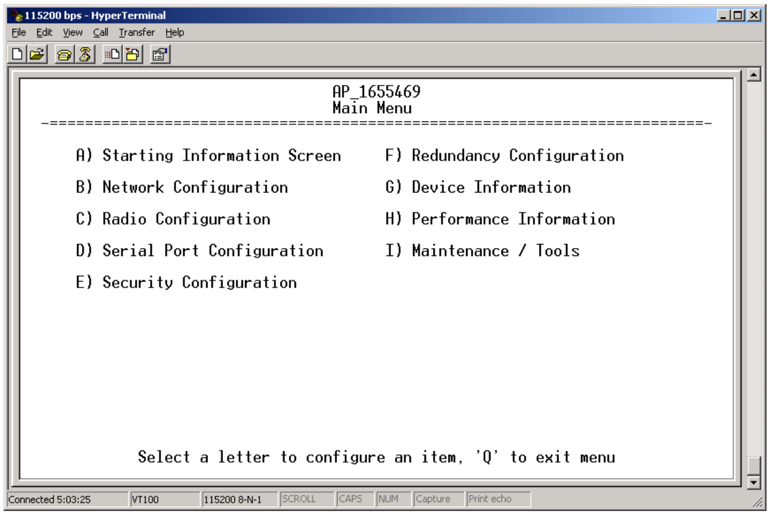
- **Scanning**—The unit is looking for an Access Point beacon signal.
- **Ranging**—Unit is adjusting power, timing, and frequency with an AP.
- **Connecting**—The unit has found a valid beacon signal for its network.
- **Authenticating**—Device is attempting device authentication.
- **Associated** —The unit has successfully synchronized and associated with an Access Point.
- **Alarmed**—The unit is has detected one or more alarms that have not been cleared.

NOTE: If an alarm is present when this screen is displayed, an "A)" appears to the left of the **Device Status** field. Pressing the "A" key on your keyboard takes you directly to the "Current Alarms" screen.

- **Associated Remotes** (AP Only)—Indicates the number of Remotes that have achieved association with the AP.
- **Connection Status** (Remote Only)—Indicates whether the Remote has an RF connection with an AP.
- **Satellite Fix Status**—Indicates whether internal GPS receiver has achieved synchronization with GPS satellite signals.
- **Uptime**—Elapsed time since the transceiver was last booted up.
- **Firmware Version**—Version of firmware that is currently active in the unit.
- **Hardware Version**— Hardware version of the transceiver's printed circuit board.
- **Serial Number**—Make a record of this number. Provide this number when purchasing Authorization Codes to upgrade unit capabilities in the future. (See *"Authorization Codes"* on Page 138.)

3.3.2 Main Menu

The Main Menu (Figure 3-10/Figure 3-11) is the entry point for all user-controllable features. The transceiver's **Device Name** appears at the top of this and all other screens as a reminder of the unit you are currently controlling.

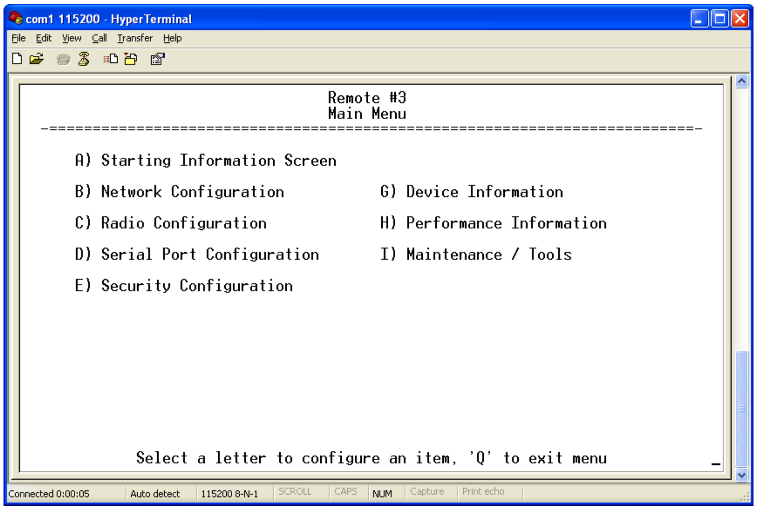


115200 bps - HyperTerminal
File Edit View Call Transfer Help
Connected 5:03:25 VT100 115200 8-N-1 SCROLL CAPS NUM Capture Print echo

```
                              AP_1655469
                              Main Menu
 -==========================================================================-

    A) Starting Information Screen      F) Redundancy Configuration

    B) Network Configuration            G) Device Information

    C) Radio Configuration              H) Performance Information

    D) Serial Port Configuration        I) Maintenance / Tools

    E) Security Configuration




           Select a letter to configure an item, 'Q' to exit menu
```

Figure 3-10. Main Menu (AP)

(AP menu shown, Remote similar; Differences noted in text below)



com1 115200 - HyperTerminal
File Edit View Call Transfer Help
Connected 0:00:05 Auto detect 115200 8-N-1 SCROLL CAPS NUM Capture Print echo

```
                              Remote #3
                              Main Menu
 -==========================================================================-

    A) Starting Information Screen

    B) Network Configuration            G) Device Information

    C) Radio Configuration              H) Performance Information

    D) Serial Port Configuration        I) Maintenance / Tools

    E) Security Configuration




           Select a letter to configure an item, 'Q' to exit menu
```

Figure 3-11. Main Menu (MDS 3650 Remote Only)

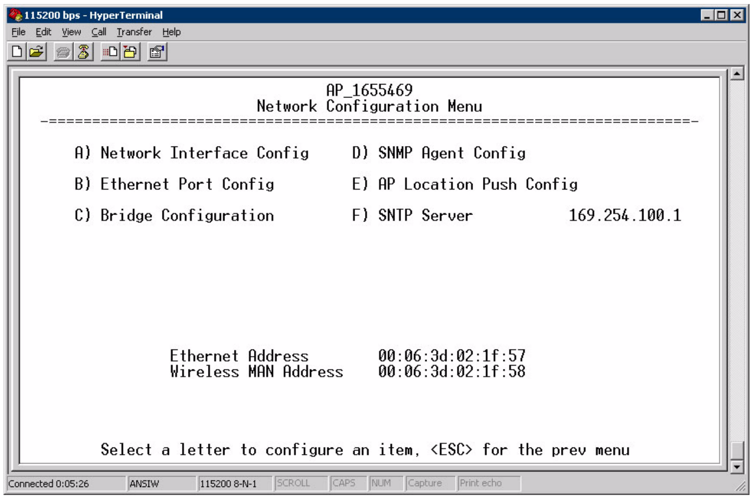
- **Starting Information Screen**—Select this item to return to the Starting Information screen described above.
- **Network Configuration**—Tools for configuring the data network layer of the transceiver. (See *"CONFIGURING NETWORK PARAMETERS"* on Page 45)
- **Radio Configuration**—Tools to configure the wireless (radio) layer of the transceiver. (See *"RADIO CONFIGURATION"* on Page 67)
- **Serial Port Configuration**—Menus for tailoring the COM1 port for data mode operation (data only). (See *"Serial Port Configuration"* on Page 78)

- **Security Configuration**—Tools to configure the security services available with the transceiver's environment. (See *"SECURITY CONFIGURATION MENU"* on Page 94)
- **Redundancy Configuration**—(AP Only) Allows setting of the criteria for switchover in the event of loss of associated Remotes or excessive packet receive errors.
- **GPS Configuration**—(Remote Only; *not* available on MDS 3650 model) View/set parameters related to GPS streaming location output. (See *"GPS CONFIGURATION (REMOTE ONLY)"* on Page 109)
- **Device Information**—Top level device fields such as model, serial number, date/time, etc. (See *"DEVICE INFORMATION MENU"* on Page 111)
- **Performance Information**—Status information relating to the radio and data layer's performance in the radio network. (See *"PERFORMANCE INFORMATION MENU"* on Page 112)
- **Maintenance/Tools**—Tools for upgrading firmware code and testing major unit capabilities. (See *"MAINTENANCE/TOOLS MENU"* on Page 125)

3.4 CONFIGURING NETWORK PARAMETERS

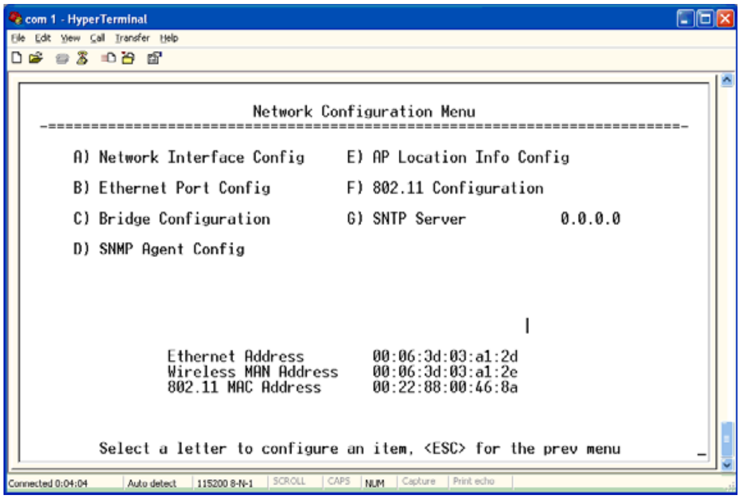
3.4.1 Network Configuration Menu

The *Network Configuration Menu* is the home of several parameters that you should review and set as necessary before placing a transceiver into service.



```
                              AP_1655469
                      Network Configuration Menu
 -==========================================================================-

      A) Network Interface Config      D) SNMP Agent Config

      B) Ethernet Port Config          E) AP Location Push Config

      C) Bridge Configuration          F) SNTP Server          169.254.100.1




                Ethernet Address        00:06:3d:02:1f:57
                Wireless MAN Address    00:06:3d:02:1f:58



         Select a letter to configure an item, <ESC> for the prev menu
```

Figure 3-12. Network Configuration Menu
(Standard radio)



```
                        Network Configuration Menu
-==========================================================================-

     A) Network Interface Config     E) AP Location Info Config
     B) Ethernet Port Config         F) 802.11 Configuration
     C) Bridge Configuration         G) SNTP Server          0.0.0.0
     D) SNMP Agent Config


             Ethernet Address        00:06:3d:03:a1:2d
             Wireless MAN Address    00:06:3d:03:a1:2e
             802.11 MAC Address      00:22:88:00:46:8a

       Select a letter to configure an item, <ESC> for the prev menu
```

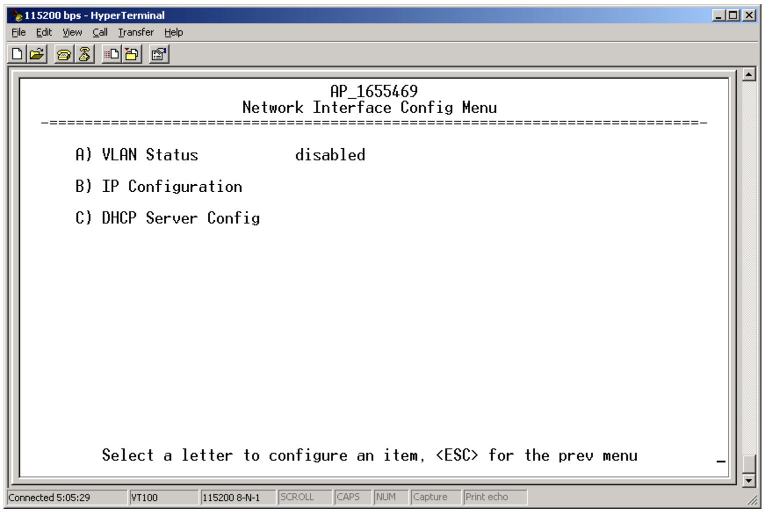
Figure 3-13. Network Configuration Menu
(Remote with WiFi)

- **Network Interface Config**—Presents a menu where you can view or set various parameters (VLAN Status, IP Configuration, and DHCP Server Configuration).
- **Ethernet Port Config**—Presents a menu for defining the status of the Ethernet port (enabled or disabled), port follows association, and Ethernet filtering configuration. Detailed explanations of this menu are contained in *Ethernet Port Configuration Menu* on Page 58.
- **Bridge Configuration**—View/set options for Ethernet Bridge operation.
- **SNMP Agent Config**—View/set SNMP configuration parameters. See *"SNMP Agent Configuration"* on Page 60 for more information.
- **AP Location Info Config**—On an AP this submenu allows for configuring an AP to automatically download the AP Locations File to its associated Remotes. On a Remote this submenu allows for downloading an AP Locations File. See *"AP Location Push Config Menu"* on Page 63 for additional details.
- **802.11 Configuration** (Remote with WiFi)—Presents a submenu for configuring the radio's internal WiFi module to be an Access Point for other WiFi devices (APs), to connect to a WiFi Access Point at another location (Station), *or* to connect directly to another WiFi device (Ad-Hoc).
- **SNTP Server**—Address of SNTP server (RFC 2030) from which the transceiver automatically gets the time-of-day. The date and time can also be set manually. A Mercury unit tries to get the time and date from the SNTP server only if an IP address is configured. It will continue to retry every minute until it succeeds.

  The transceivers use UTC (Universal Time Coordinated) with a configurable time offset. [**0**]

NOTE: The Mercury obtains time of day data from the GPS receiver, if the receiver has a satellite fix. If an SNTP server is configured and both it and the GPS are available, the Mercury gets its date and time from the SNTP server.

Network Interface Configuration Submenu



```
                              AP_1655469
                      Network Interface Config Menu
=========================================================================

     A) VLAN Status          disabled

     B) IP Configuration

     C) DHCP Server Config

        Select a letter to configure an item, <ESC> for the prev menu
```

Figure 3-14. Network Interface Configuration Submenu

- **VLAN Status**—This selection is used to enable or disable virtual LAN operation. For details, refer to *VLAN Configuration Menu* on Page 47. [**enable, disabled; disabled**]
- **IP Configuration**—This selection presents a submenu for configuring the local IP address of the transceiver. Detailed explanations are provided in the section titled *IP Configuration Menu* on Page 53.
- **DHCP Server Config**—Menu for configuration of DHCP services by the Access Point. DHCP provides “on-the-fly” IP address assignments to other LAN devices, including Mercury Series units. For details, refer to *DHCP Server Configuration (Data and Mgmt)* on Page 50.

VLAN Configuration Menu

The VLAN Configuration menu (Figure 3-15) becomes active and visible when you enable **VLAN Status** on the Network Interface Configuration Menu, and you press the Enter key.

CAUTION: The VLAN Status parameter must be consistent at both the Access Point and Remote radios in order for data to flow correctly. Failure to do so might result in data not being transported correctly even when the radios are in an associated state and able to communicate over-the-air.

About Virtual LAN in Mercury

A VLAN is essentially a limited broadcast domain, meaning that all members of a VLAN receive broadcast frames sent by members of the same VLAN but *not* frames sent by members of a different VLAN. For more information, refer to the IEEE 802.1Q standard.

The transceiver supports port-based VLAN at the Ethernet interface and over the air, according to the IEEE 802.1Q standard. When **VLAN Status** is enabled, the wireless port of both AP and Remote radios act, according to user configuration, as either a trunk port or access port.

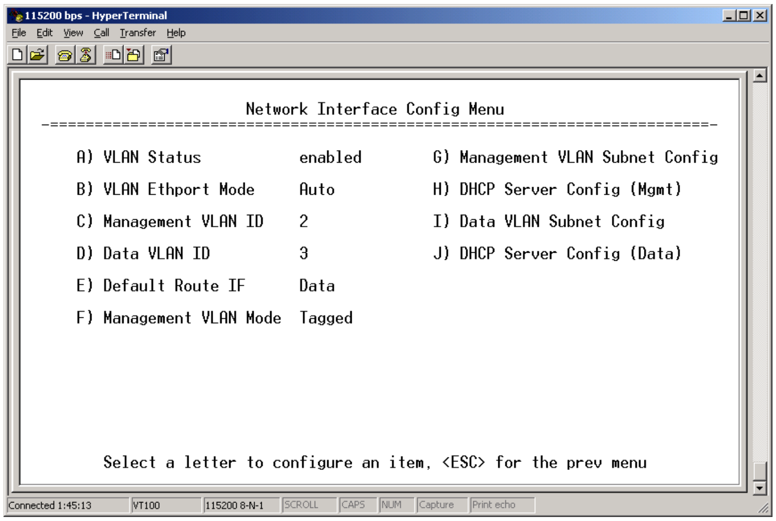
The Ethernet port of an Access Point radio is normally configured as a trunk port. This type of port expects incoming frames to have a **VLAN ID** tag and sends outgoing frames with a VLAN tag as well.

The Ethernet port of a Mercury radio can be configured as an access port or as a trunk port.

When the Ethernet port of a Mercury radio is configured as VLAN Access Port, the radio tags incoming traffic with a VLAN ID, and strips the tag before sending traffic out. This VLAN is known as the DATA VLAN. Additionally, a second VLAN is assigned for other traffic that is terminated at the radio, such as SNMP, TFTP, ICMP, Telnet, and so on. This is known as the MANAGEMENT VLAN. Traffic directed to the integrated terminal server that handles the serial ports is assigned to the DATA VLAN.

When the Ethernet port of a remote radio is configured as a VLAN trunk, the radio expects all incoming Ethernet frames to be tagged, and passes all outgoing frames as received from the wireless link, with the unchanged VLAN tag.

Network Interface Configuration Submenu—VLAN Items

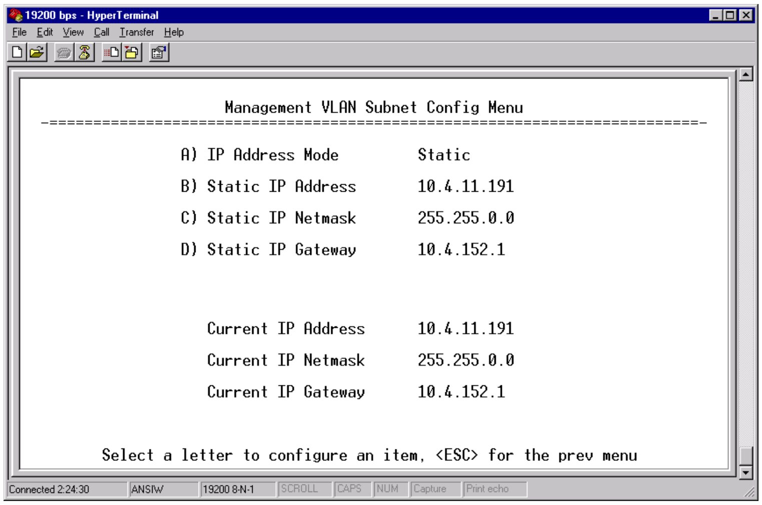


```
                         Network Interface Config Menu
  =========================================================================-

     A) VLAN Status          enabled       G) Management VLAN Subnet Config
     B) VLAN Ethport Mode    Auto          H) DHCP Server Config (Mgmt)
     C) Management VLAN ID   2             I) Data VLAN Subnet Config
     D) Data VLAN ID         3             J) DHCP Server Config (Data)
     E) Default Route IF     Data
     F) Management VLAN Mode Tagged




        Select a letter to configure an item, <ESC> for the prev menu
```

Figure 3-15. VLAN Configuration Menu

- **VLAN Status**—Defines whether the radio handles Ethernet frames in "extended" 802.1Q mode or in "normal" mode in the Ethernet port. If configured with a trunk port, the Mercury passes all tagged traffic regardless of the VLAN ID. The Mercury only uses the **Data VLAN ID** parameter when the ETH port is configured as an Access Port.
[**enabled, disabled; disabled**]
- **VLAN Ethport Mode**—Defines if the Ethernet port acts as a trunk port or as an access port. Auto mode defines the port as a trunk port in an AP, or an access port in a Remote radio.
[**Auto, Trunk, Access; Auto**]
- **Management VLAN ID**—Defines the VLAN ID for traffic directed to the radio itself, other than the terminal server process. This VLAN ID is used for filtering and for tagging purposes.
[**1-4094; 2**]
- **Data VLAN ID**—Defines the VLAN ID assigned to traffic directed to and from the Ethernet port and the terminal server process in the radio. This VLAN ID is used for filtering and tagging purposes. [**1-4094; 3**]
- **Default Route IF**—Defines the VLAN that contains the default gateway in the radio. [**MGMT, DATA; MGMT**]
- **Management VLAN Mode**—Applies the VLAN tag to management frames. [**Tagged, Native; Tagged**].
- **Management VLAN Subnet Config**—Presents a screen where you can set the IP Address Mode, Static IP Address, and Static IP Netmask (see Figure 3-16 on Page 50).
- **DHCP Server Config (Mgmt)**—Presents a screen where you can view or set the DHCP server status and address information for management functions (see Figure 3-17 on Page 51).
- **Data VLAN Subnet Config**—Presents a screen where you can view or set the IP mode and address information (see Figure 3-19 on Page 52).
- **DHCP Server Config (Data)**—Presents a screen where you can view or set DHCP server status and address information for data functions (see Figure 3-18 on Page 52).

Management VLAN Subnet Configuration Menu



```
                    Management VLAN Subnet Config Menu
 -==========================================================================-

                  A) IP Address Mode        Static
                  B) Static IP Address      10.4.11.191
                  C) Static IP Netmask      255.255.0.0
                  D) Static IP Gateway      10.4.152.1


                     Current IP Address     10.4.11.191
                     Current IP Netmask     255.255.0.0
                     Current IP Gateway     10.4.152.1


          Select a letter to configure an item, <ESC> for the prev menu
```

Figure 3-16. Management VLAN Subnet Configuration Menu

NOTE: Changes to any of the following parameters while communicating over the network (LAN or over-the-air) might cause a loss of communication with the unit you are configuring. You must re-establish communication using the new IP address.

- **IP Address Mode**—Defines the source of the IP address of this device. Only static IP addressing mode is available when VLAN Status is enabled. [**Static, Dynamic; Static**]
- **Static IP Address**—The IPv4 local IP address. [**192.168.1.1**]
- **Static IP Netmask**—The IPv4 local subnet mask. This value is used when the radio attempts to send a locally initiated message, either from the terminal server, or from a management process. [**255.255.0.0**]

The lower three lines of the screen (**Current IP Address**, **Current IP Netmask**, **Current IP Gateway**) show the current addressing configured at the transceiver. **Current IP Gateway** only displays on this screen if **Default Route IF** on the **Network Interface Config** menu (Figure 3-15 on Page 48) is set to **Management.**

Selecting option **I** from the VLAN Configuration Menu displays the screen shown in Figure 3-19 on Page 52. Note that the IP address is different even though it is the same physical unit. This is because this IP address is defined for a different VLAN.

DHCP Server Configuration (Data and Mgmt)

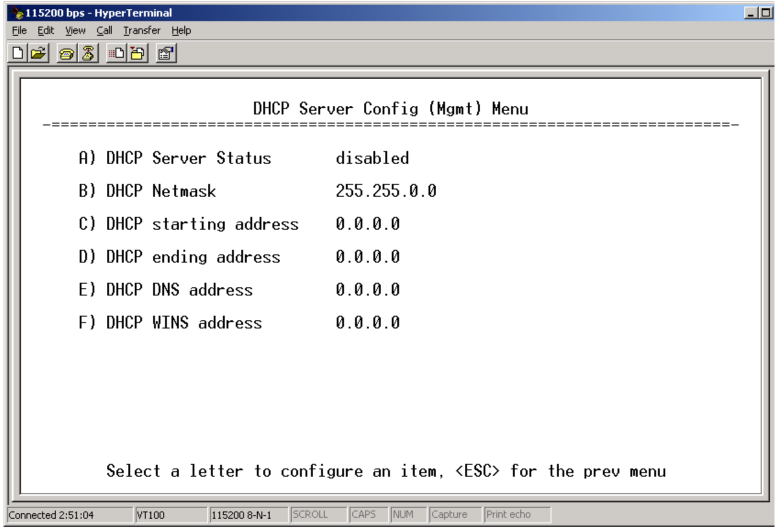
A transceiver can provide automatic IP address assignments to other IP devices in the network by providing DHCP (Dynamic Host Configuration Protocol) services. This service eliminates setting an individual device IP address on Remotes in the network, but it requires some planning of the IP address range. One drawback to network-wide automatic IP address assignments is that SNMP services might become inaccessible as they are dependent on fixed IP addresses.

You can make a network of radios with the DHCP-provided IP address enabled or with DHCP services disabled. In this way, you can accommodate locations for which a fixed IP address is desired.

NOTE: There should be only one active DHCP server in a network. If more than one DHCP server exists, network devices might randomly get their IP address from different servers every time they request one.

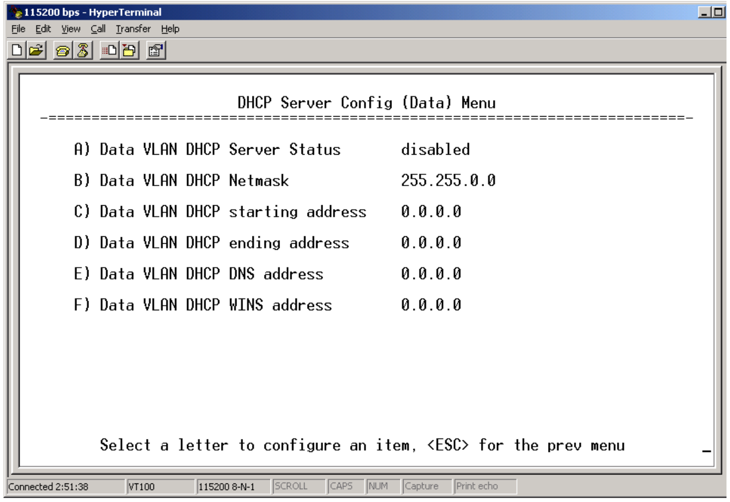
NOTE: Combining DHCP and IEEE 802.1x device authentication might result in a non-working radio if the DHCP server is located at a Remote radio site. If possible, place the DHCP server at the AP location.

A DHCP server can be run at a Remote, but it is not recommended if 802.1x Device Authentication is in use and if the AP gets its IP address from the DHCP server on the Remote. In this case, the Remote cannot authenticate to allow the AP to get its address, because the AP needs an address to perform 802.1x device authentication. This results in an unsolvable condition where the AP needs to get an IP address from DHCP at the Remote, but it can't get the address until it is authenticated.



```
                       DHCP Server Config (Mgmt) Menu
 -============================================================================-

     A) DHCP Server Status       disabled

     B) DHCP Netmask             255.255.0.0

     C) DHCP starting address    0.0.0.0

     D) DHCP ending address      0.0.0.0

     E) DHCP DNS address         0.0.0.0

     F) DHCP WINS address        0.0.0.0





        Select a letter to configure an item, <ESC> for the prev menu
```

Figure 3-17. DHCP Server Configuration (Mgmt) Menu

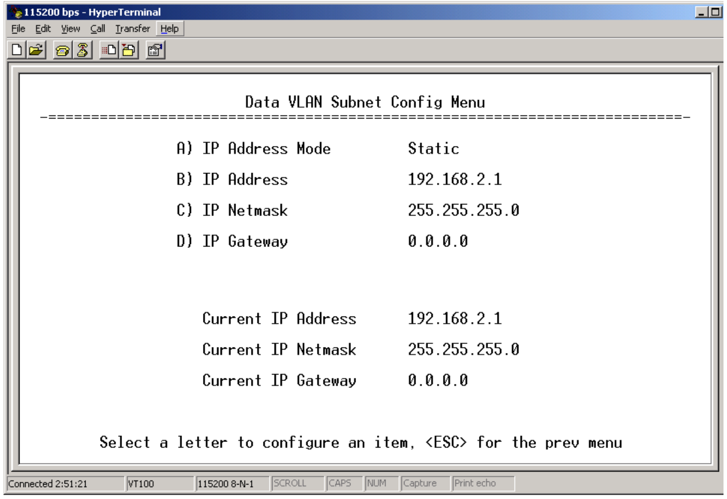


```
                     DHCP Server Config (Data) Menu
-===========================================================================-

    A) Data VLAN DHCP Server Status       disabled

    B) Data VLAN DHCP Netmask             255.255.0.0

    C) Data VLAN DHCP starting address    0.0.0.0

    D) Data VLAN DHCP ending address      0.0.0.0

    E) Data VLAN DHCP DNS address         0.0.0.0

    F) Data VLAN DHCP WINS address        0.0.0.0




       Select a letter to configure an item, <ESC> for the prev menu
```

Figure 3-18. DHCP Server Configuration (Data) Menu

- **DHCP Server Status**—Enable/Disable the response to DHCP requests to assign an IP address. [**Disabled/Enabled; Disabled**]
- **DHCP Netmask**—IP netmask to be assigned along with the IP address in response to a DHCP request. [**0.0.0.0**]
- **DHCP starting address**—Lowest IP address in the range of addresses provided by this device. [**0.0.0.0**]
- **DHCP ending address**—Highest IP address in the range of addresses provided by this device. A maximum of 256 addresses is allowed in this range. [**0.0.0.0**]
- **DHCP DNS address**—Domain Name Server address provided by this service.
- **DHCP WINS address**—Windows Internet Naming Service server address provided by this service.

Data VLAN Subnet Configuration Menu



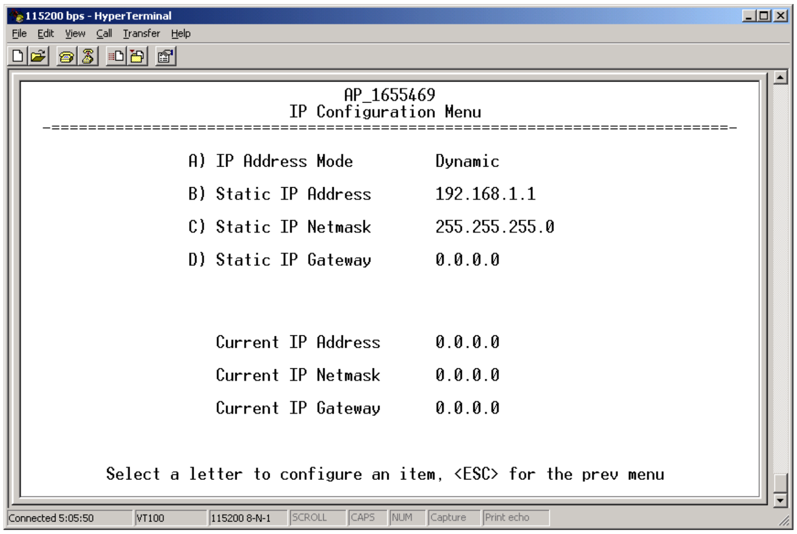
```
                        Data VLAN Subnet Config Menu
-===========================================================================-

                 A) IP Address Mode        Static

                 B) IP Address             192.168.2.1

                 C) IP Netmask             255.255.255.0

                 D) IP Gateway             0.0.0.0


                    Current IP Address     192.168.2.1

                    Current IP Netmask     255.255.255.0

                    Current IP Gateway     0.0.0.0


       Select a letter to configure an item, <ESC> for the prev menu
```

Figure 3-19. Data VLAN Subnet Configuration Menu

- **IP Address Mode**—Defines the source of this device's IP address. Only static IP addressing mode is available when VLAN Status is enabled [**Static; Static**]
- **IP Address**—The IPv4 local IP address. [**192.168.1.1**]
- **IP Netmask**—The IPv4 local subnet mask. This value is used when the radio attempts to send a locally initiated message, from either the terminal server or the management process. [**255.255.0.0**]
- **IP Gateway**—The IPv4 address of the default gateway device, typically a router. [**0.0.0.0**]

The lower three lines of the screen (**Current IP Address**, **Current IP Netmask**, and **Current IP Gateway**) show the current addressing configured at the transceiver. **Current IP Gateway** only displays on this screen if **Default Route IF** on the **Network Interface Config** menu (Figure 3-15 on Page 48) is set to **Data.**

IP Configuration Menu



```
                              AP_1655469
                          IP Configuration Menu
 -=========================================================================-

               A) IP Address Mode         Dynamic

               B) Static IP Address       192.168.1.1

               C) Static IP Netmask       255.255.255.0

               D) Static IP Gateway       0.0.0.0


                  Current IP Address      0.0.0.0

                  Current IP Netmask      0.0.0.0

                  Current IP Gateway      0.0.0.0


       Select a letter to configure an item, <ESC> for the prev menu
```

Figure 3-20. IP Configuration Menu

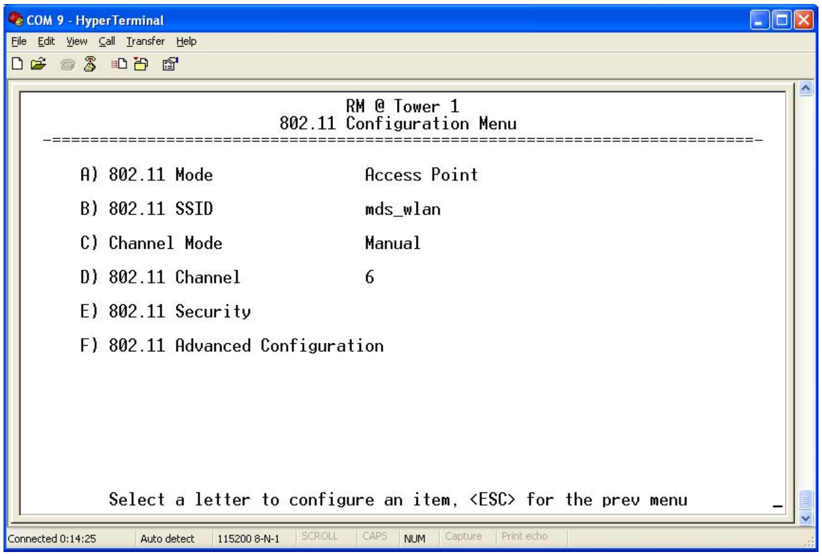
CAUTION: Changes to the following parameters while communicating over the network (LAN or over-the-air) might cause a loss of communication with the unit being configured. You must re-establish communication using the new IP address.

- **IP Address Mode**—Defines the source of this device's IP address. [**Static, Dynamic; Static**]
- **Static IP Address** *(User Review Recommended)*—Essential for connectivity to the transceiver's MS using the LAN port. Enter any valid IP address that is unique within the network. This field is unnecessary if DHCP is enabled. [**192.168.1.1**]
- **Static IP Netmask**—The IPv4 local subnet mask. This field is unnecessary if DHCP is enabled. [**255.255.0.0**]

- **Static IP Gateway**—The IPv4 address of the network gateway device, typically a router. This field is unnecessary if DHCP is enabled. [**0.0.0.0**]

  The lower three items on the screen (Current IP Address, Netmask and Gateway) show the actual addressing at the transceiver whether it was obtained from static configuration or from a DHCP server.

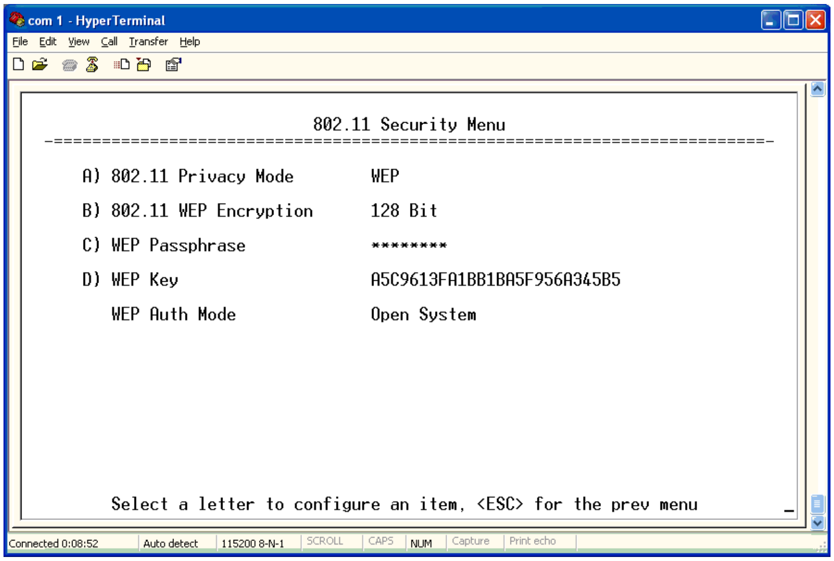
802.11 Configuration Submenu



```
                              RM @ Tower 1
                        802.11 Configuration Menu
 -===========================================================================-

     A) 802.11 Mode                Access Point

     B) 802.11 SSID                mds_wlan

     C) Channel Mode               Manual

     D) 802.11 Channel             6

     E) 802.11 Security

     F) 802.11 Advanced Configuration




          Select a letter to configure an item, <ESC> for the prev menu
```

Figure 3-21. 802.11 Configuration Submenu

- **802.11 Mode**—Configures the WiFi radio to be an Access Point for other WiFi devices (**Access Point**), to connect to a WiFi Access Point at another location (**Station**), to connect directly to another WiFi device (**Ad-Hoc**), or to be disabled (**disabled**). The default setting is **disabled.**
- **802.11 SSID**—Service Set Identifier, the name of the wireless LAN to which to connect. This is equivalent to Network Name in GE MDS terminology.
- **802.11 Channel**—*(Applies only when 802.11 Mode is set to* **Access Point***)* Sets the 802.11 channel the device will use. This can only be set to **Auto** when in Station mode.



```
                          802.11 Security Menu
 -=============================================================================-

    A) 802.11 Privacy Mode         WEP

    B) 802.11 WEP Encryption       128 Bit

    C) WEP Passphrase              ********

    D) WEP Key                     A5C9613FA1BB1BA5F956A345B5

       WEP Auth Mode               Open System






       Select a letter to configure an item, <ESC> for the prev menu
```

Figure 3-22. 802.11 Security Menu
(WEP mode shown; Other selections/parameters described below)

- **802.11 Privacy Mode**—Determines which privacy mode is used. [**None, WEP, WPA-PSK, WPA Enterprise, WPA2 personal, WPA2 Enterprise; None**] The 802.11 Security Menu appears differently depending on which privacy mode is selected. The example shown is for **WEP** Privacy Mode, but several other selections are possible as listed at the end of these descriptions.
- **802.11 Encryption**—Determines the strength of the WEP encryption. [**64 Bit, 128 Bit; 128 Bit**]
- **WEP Passphrase**—A user-entered combination of characters that is used to generate a WEP Key.
- **WEP Key**—A security code that is generated using the Wireless Equivalency Protocol. It is generated by the entry of a WEP Passphrase (see above) This key should be entered in hexadecimal format preceded by **0x**. The key should be 13 or 26 hexadecimal characters. For example, **1a2b3c4d5e6f709a8b7c6d5e4f**.
- **WEP Auth Mode**—Determines the authentication mode used by the radio. This parameter is not configurable, as the radio only supports Open System. The entry is provided as a reminder of the mode, but it cannot be changed.

Other Privacy Modes (besides WEP) are as follows:

- **WPA-PSK**—This is for WiFi Protected Access with a Preshared Key. The menu options for this privacy mode are as follows:

  802.11 WPA Encryption—The WiFi Protected Access encryption method used by the radio. CCMP is an AES-based algorithm **[TKIP, CCMP; TKIP]**

  Preshared Key—A user generated combination of ASCII or hexadecimal characters. The preshared key may be any length between 8 and 63 ASCII characters, but longer keys are considered more secure. If using hexadecimal characters, it must be exactly 64 characters long.

- **WPA Enterprise**—This submenu menu differs, depending on whether the radio is configured as a WiFi *Access Point* or a WiFi *Station*. The menu options for this mode (as a Station) are:

WPA Enterprise as a Station

802.11 WPA Encryption□Same as described above (for WPA-PSK).

EAP Method—The authentication framework used in WPA Enterprise or WPA2 Enterprise mode. As of the date of publishing, the only option is **EAP-TLS**.

Certificates to Use—You may use the same certificates that are used for IEEE 802.1x user and device authentication, if desired. These appear in the menu as WiMax certificates. WiFi certificates are certificates loaded on the radio that are only used for WPA Enterprise or WPA2 Enterprise authentication. **[WiMax certificates, WiFi certificates; WiMax certificates]**

Manage Certificates—This selection brings up a menu where you can download the certificates needed for authentication. It is the same as the menu used in 802.1x user and device authentication.

WPA Enterprise as an Access Point

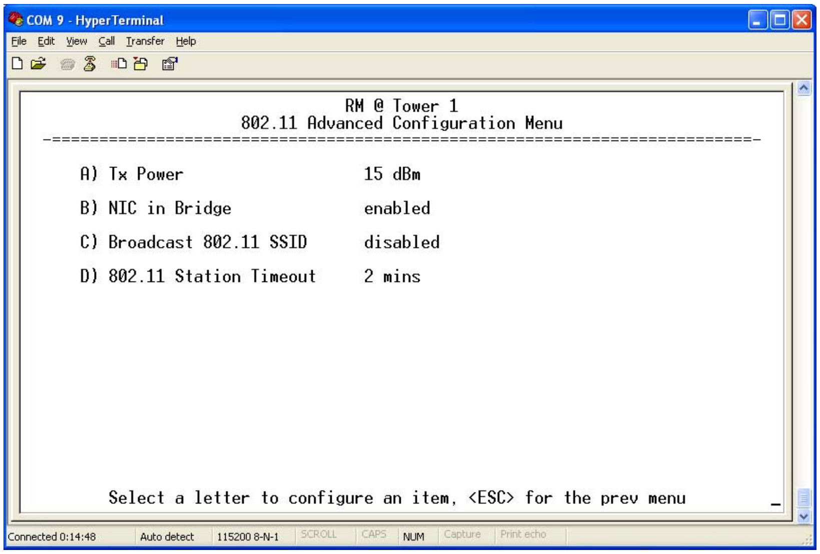
The menu options for **WPA Enterprise** (as an Access Point) are the same as described above for **WPA Encryption**, and **EAP Method** parameters, but there is no **Manage Certificates** menu. In addition, a new menu option is shown: **RADIUS Configuration**.

Selecting **Radius Configuration** brings up a submenu where you can specify the RADIUS server to use. The same RADIUS configuration is used for user and device authentication, as well as WiFi WPA Enterprise or WPA2 Enterprise authentication.

WPA2 Personal—The menu looks the same as for WPA-PSK, except the 802.11 Privacy Mode at the top of the screen shows **WPA2 Personal**. Both **WPA2 Personal** and **WPA2 Enterprise** use the new WPA2 Protocol.

WPA2 Enterprise—The menu looks the same as WPA Enterprise with the exception of the 802.11 Privacy Mode at the top of the screen, which shows **WPA2 Enterprise** instead.

NOTE: For complete information on using WPA Enterprise and WPA2 Enterprise, see □*NOTES ON WPA/WPA2 WiFi SECURITY*□on Page 186.

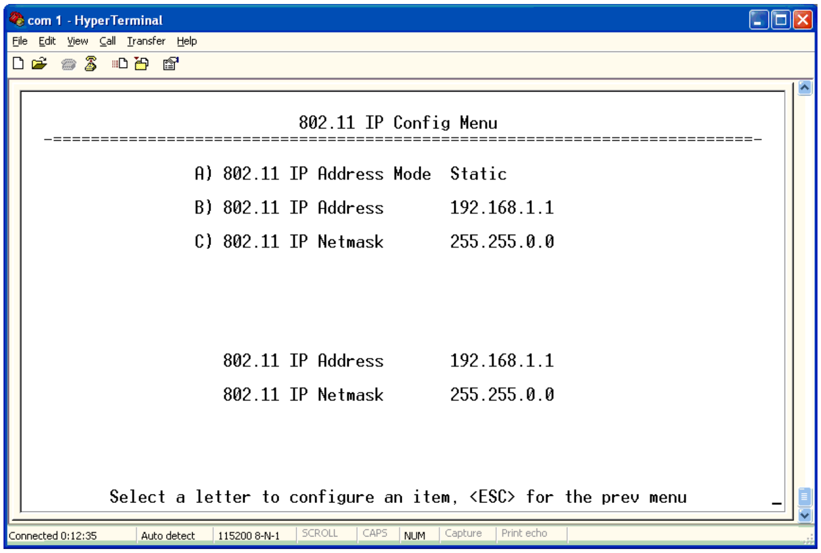


```
                              RM @ Tower 1
                   802.11 Advanced Configuration Menu
-==========================================================================-

     A) Tx Power                    15 dBm

     B) NIC in Bridge               enabled

     C) Broadcast 802.11 SSID       disabled

     D) 802.11 Station Timeout      2 mins








        Select a letter to configure an item, <ESC> for the prev menu
```

Figure 3-23. 802.11 Advanced Configuration Menu

- **TX Power**—Transmit power of the WiFi radio. [**1** to **18; 15**]
- **NIC in Bridge**—When enabled, the WiFi interface is added to the Network Interface Card bridge, allowing traffic to pass between the WiFi and the other interfaces (LAN and wireless). [**enabled, disabled; enabled**]

  When disabled, an additional menu item appears, called **802.11 IP Config**. When this item is selected, the 802.11 IP Configuration Menu appears (see Figure 3-24).
- **Broadcast 802.11 SSID**—When enabled, the SSID of the WiFi Access Point is broadcast over the air so that stations will detect the AP’s presence. [**enabled, disabled; enabled**]
- **802.11 Station Timeout**—Determines how quickly inactive stations are “aged out” of he WiFi Access Point’s database. [**1** to **240 mins**; **2 mins**]



```
                         802.11 IP Config Menu
-==========================================================================-

              A) 802.11 IP Address Mode  Static
              B) 802.11 IP Address       192.168.1.1
              C) 802.11 IP Netmask       255.255.0.0



                 802.11 IP Address       192.168.1.1
                 802.11 IP Netmask       255.255.0.0


        Select a letter to configure an item, <ESC> for the prev menu
```

Figure 3-24. 802.11 IP Configuration Menu

This menus allows assignment of the IP mode and address of the WiFi module. You can only do this if NIC In Bridge is disabled. This screen is nearly the same as the other IP configuration menus, except there is no gateway.

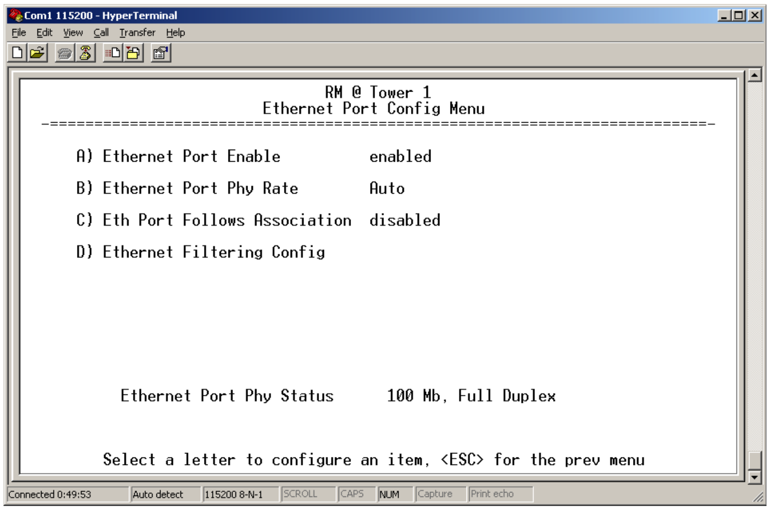
- **802.11 IP Address Mode**—Defines the source of the IP address of the WiFi device. [**Static, Dynamic; Static**]
- **802.11 IP Address**—The IPv4 local IP address. [**192.168.1.1**]
- **Static IP Netmask**—The IPv4 local subnet mask. [**255.255.0.0**]

3.4.2 Ethernet Port Configuration Menu

The transceiver allows for special control of the Ethernet interface, to allow traffic awareness and availability of the backhaul network for redundancy purposes.

NOTE: The transceiver’s network port supports 10BaseT and 100BaseT connections. Confirm that your hub/switch is capable of auto-switching data rates.

To prevent excessive Ethernet traffic from degrading performance, place the transceiver in a segment, or behind routers.

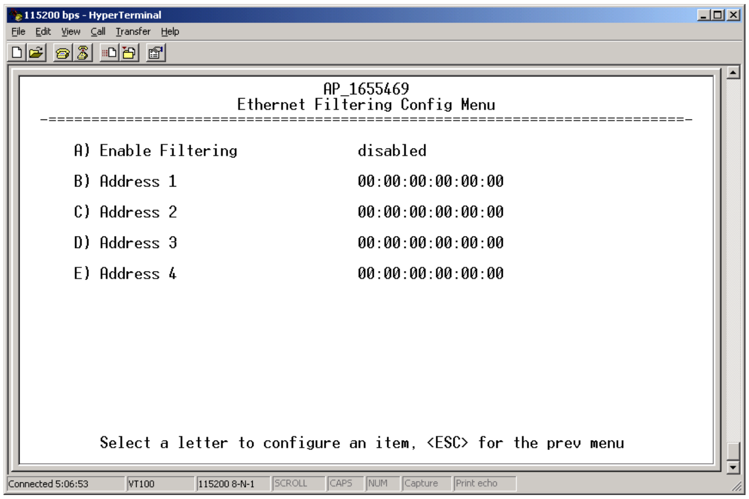


```
                               RM @ Tower 1
                         Ethernet Port Config Menu
-==========================================================================-

     A) Ethernet Port Enable          enabled

     B) Ethernet Port Phy Rate        Auto

     C) Eth Port Follows Association  disabled

     D) Ethernet Filtering Config




          Ethernet Port Phy Status      100 Mb, Full Duplex


        Select a letter to configure an item, <ESC> for the prev menu
```

Figure 3-25. Ethernet Port Configuration Menu

- **Ethernet Port Enable**—Allows enabling/disabling Ethernet traffic for security purposes. Setting it to **enabled** enables the port. [**enabled, disabled; enabled**]
- **Ethernet Port Phy Rate**—The Ethernet port's configured speed.
- **Eth Port Follows Association** (Remote Only)—When enabled, the Ethernet port is disabled until the Remote associates. This allows a PC or laptop connected to the Remote to know when the wireless link is available. This feature helps middleware on the laptop in making connectivity decisions. In addition, if the Remote moves between Access Points on different subnets, then the laptop can DHCP for a new address when the link comes back up. [**enabled, disabled; disabled**]
- **Ethernet Filtering Config**—Allows enabling/disabling filtering and specifying of Ethernet addresses.

Ethernet Filtering Configuration Menu

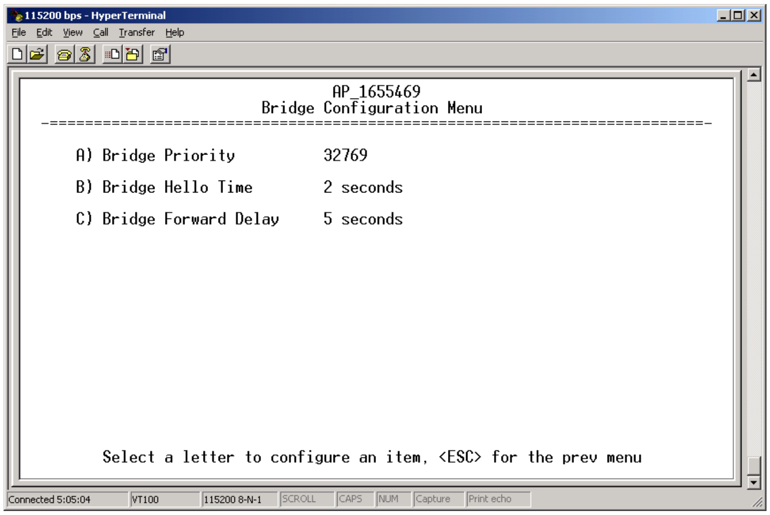


```
                               AP_1655469
                        Ethernet Filtering Config Menu
-==========================================================================-

     A) Enable Filtering               disabled

     B) Address 1                      00:00:00:00:00:00

     C) Address 2                      00:00:00:00:00:00

     D) Address 3                      00:00:00:00:00:00

     E) Address 4                      00:00:00:00:00:00




        Select a letter to configure an item, <ESC> for the prev menu
```

Figure 3-26. Ethernet Filtering Configuration Menu

- **Enable Filtering**—Activates Ethernet filtering.
  [**enabled, disabled; disabled**]
- **Address 1, 2, 3, 4**—Ethernet address fields. When filtering is enabled, the Mercury only accepts traffic on its Ethernet port from the configured addresses.
  [**Valid MAC address string**]
- **Ethernet MAC Address Filtering**—This feature filters out all unicast Ethernet frames on the LAN interface that are not in the filtering address list. The filtering address list can be populated with up to four Ethernet addresses. This feature is typically employed at the Remotes to guard against unwanted traffic being forwarded into the wireless network.

3.4.3 Bridge Configuration



```
                              AP_1655469
                        Bridge Configuration Menu
 -===========================================================================-

      A) Bridge Priority          32769

      B) Bridge Hello Time        2 seconds

      C) Bridge Forward Delay     5 seconds







         Select a letter to configure an item, <ESC> for the prev menu
```

Figure 3-27. Bridge Configuration Menu

- **Bridge Priority**—View/set the priority of the bridge in the spanning tree. [**0-65535; 32769**]
- **Bridge Hello Time**—View/set spanning tree hello time. This parameter affects how often the bridge sends a spanning tree Bridge Protocol Data Unit (BPDU). [**1-10 seconds; 2 seconds**]
- **Bridge Forward Delay**—View/set spanning tree forwarding delay. Affects how long the bridge spends listening and learning after initialization. [**4-30 seconds; 5 seconds**].

3.4.4 SNMP Agent Configuration

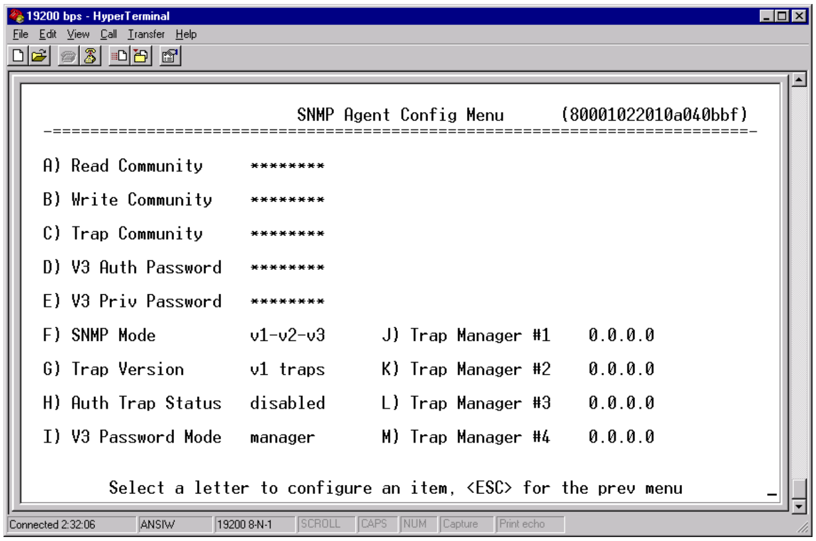
The transceiver contains over 100 custom SNMP-manageable objects as well as the IETF standard RFC1213 for protocol statistics, also known as MIB II. You can use off-the-shelf SNMP managers to access the transceiver’s SNMP Agent’s MIB, such as Castle Rock Computing *SNMPc*™ and Hewlett Packard *OpenView*™. The transceiver’s SNMP agent supports SNMPv1, v2, and v3.

The objects are split into nine MIB files for use with your SNMP manager. There are textual conventions, common files, and specific files. This allows the flexibility to change areas of the MIB and not affect other existing installations or customers.

- **msdreg.mib**—MDS sub-tree registrations
- **mds_comm.mib**—MDS Common MIB definitions for objects and events common to the entire product family
- **mercury_reg.mib**—MDS sub-tree registrations
- **mercurytrv1.mib**—SNMPv1 enterprise-specific traps
- **mercurytrv2.mib**—SNMPv2 enterprise-specific traps
- **mercury_comm.mib**— MIB definitions for objects and events common to the entire Mercury Series
- **mercury_ap.mib**—MIB definitions for objects and events for an Access Point transceiver
- **mercury_rem.mib**—Definitions for objects and events for a Remote radio
- **mercury_sec.mib**—For security management of the radio system

NOTE: SNMP management requires that the proper IP address, network, and gateway addresses are configured in each associated network transceiver.

In addition, some management systems might require that you compile the MIB files in the order shown above.



```
                             SNMP Agent Config Menu      (80001022010a040bbf)
 -=========================================================================-

 A) Read Community     ********

 B) Write Community    ********

 C) Trap Community     ********

 D) V3 Auth Password   ********

 E) V3 Priv Password   ********

 F) SNMP Mode          v1-v2-v3      J) Trap Manager #1    0.0.0.0

 G) Trap Version       v1 traps      K) Trap Manager #2    0.0.0.0

 H) Auth Trap Status   disabled      L) Trap Manager #3    0.0.0.0

 I) V3 Password Mode   manager       M) Trap Manager #4    0.0.0.0

        Select a letter to configure an item, <ESC> for the prev menu
```

Figure 3-28. SNMP Server Configuration Menu

This menu provides configuration and control of vital SNMP functions.

- **Read Community String**—SNMP community name with SNMPv1/SNMPv2c read access. This string can contain up to 30 alpha-numeric characters.

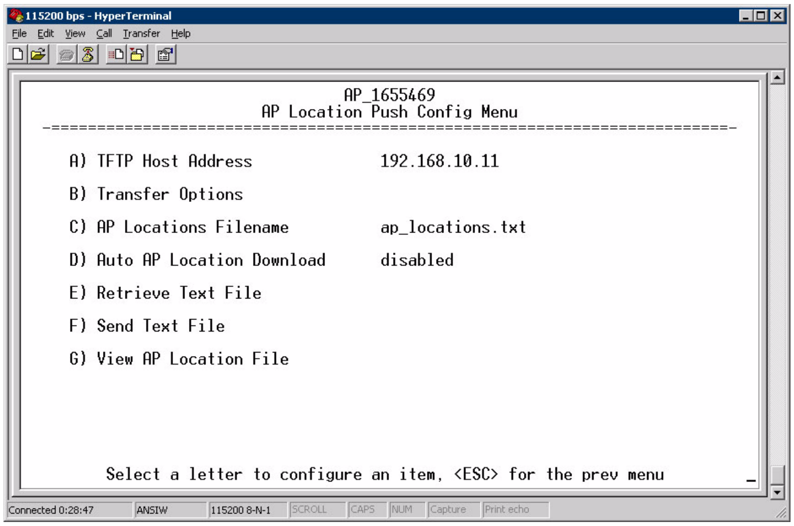
- **Write Community String**—SNMP community name with SNMPv1/SNMPv2c write access. This string can contain up to 30 alpha-numeric characters.
- **Trap Community String**—SNMP community name with SNMPv1/SNMPv2c trap access. This string can contain up to 30 alpha-numeric characters.
- **V3 Authentication Password**—Authentication password stored in flash memory. This is used when the Agent is managing passwords locally (or initially for all cases on reboot). This is the SNMPv3 password used for Authentication (currently, only MD5 is supported). This string can contain up to 30 alpha-numeric characters.
- **V3 Privacy Password**—Privacy password stored in flash memory. Used when the SNMP Agent is managing passwords locally (or initially for all cases on reboot). This is the SNMPv3 password used for privacy (DES encryption). This string can contain between 8 and 30 alpha-numeric characters.
- **SNMP Mode**—This specifies the mode of operation of the radio's SNMP Agent. The choices are: **disabled**, **v1_only**, **v2_only**, **v3_only**, **v1-v2**, and **v1-v2-v3**. If the mode is **disabled**, the Agent does not respond to any SNMP traffic. If the mode is **v1_only**, **v2_only**, or **v3_only**, the Agent responds only to that version of SNMP traffic. If the mode is **v1-v2** or **v1-v2-v3**, the Agent responds to the specified version of SNMP traffic. [**v1-v2-v3**]
- **Trap Version**—This specifies which version of SNMP is used to encode the outgoing traps. The choices are **v1_traps**, **v2_traps**, and **v3_traps**. When **v3_traps** is selected, v2-style traps are sent, but with a v3 header. [**v1_traps, v2_traps, v3_traps**]
- **Auth Traps Status**—Indicates whether or not traps are generated for failed authentication of an SNMP PDU. [**Disabled/Enabled; Disabled**]
- **SNMP V3 Passwords**—Determines whether v3 passwords are managed locally or via an SNMP Manager. The different behaviors of the Agent, depending on the mode selected, are described in **SNMP Mode** above.
- **Trap Manager #1—#4**— Table of up to four locations on the network to which traps are sent. [**Any standard IP address**]

NOTE: The number in the upper right-hand corner of the screen is the SNMP Agent's SNMPv3 Engine ID. Some SNMP Managers may need to know this ID in order interface with the transceiver's SNMP Agent. The ID only appears on the screen when SNMP Mode is either **v1-v2-v3** or **v3_only**.

NOTE: For more SNMP information, see *"NOTES ON SNMP"* on Page 182.

3.4.5 AP Location Push Config Menu

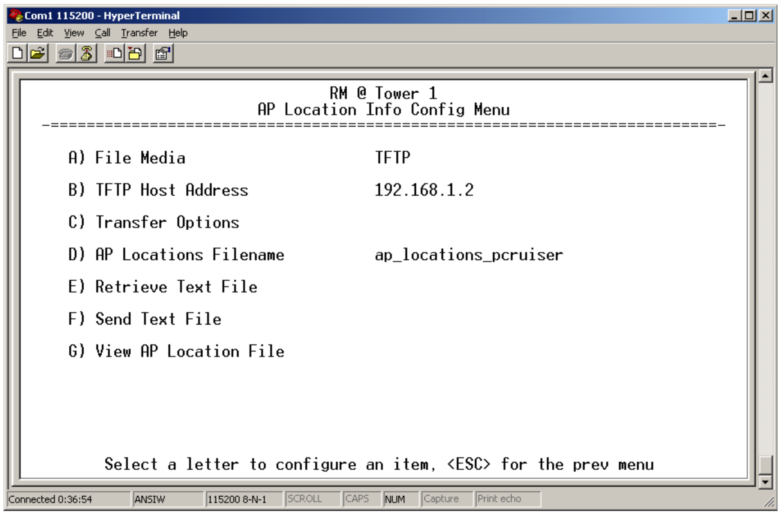
This menu configures the AP for updating connected remotes with the AP Locations File loaded on the AP.



115200 bps - HyperTerminal
File Edit View Call Transfer Help
Connected 0:28:47 ANSIW 115200 8-N-1 SCROLL CAPS NUM Capture Print echo

```
                              AP_1655469
                      AP Location Push Config Menu
 -==========================================================================-

     A) TFTP Host Address             192.168.10.11

     B) Transfer Options

     C) AP Locations Filename         ap_locations.txt

     D) Auto AP Location Download     disabled

     E) Retrieve Text File

     F) Send Text File

     G) View AP Location File



         Select a letter to configure an item, <ESC> for the prev menu
```

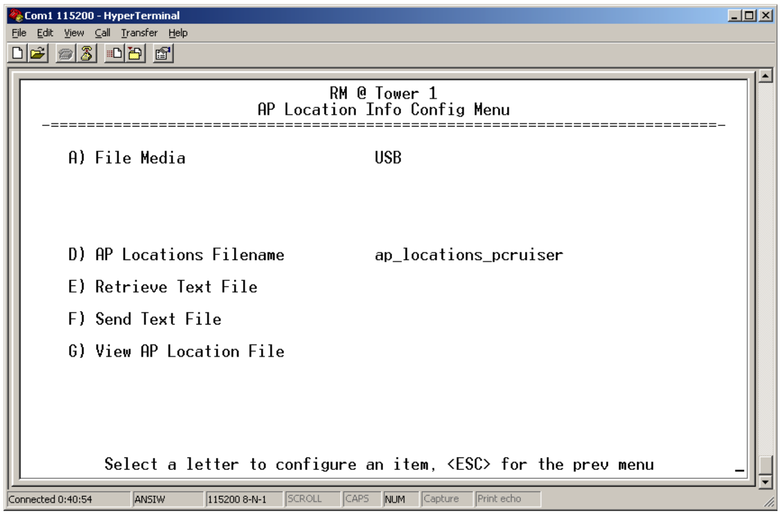
Figure 3-29. AP Location Push Config Menu



Com1 115200 - HyperTerminal
File Edit View Call Transfer Help
Connected 0:36:54 ANSIW 115200 8-N-1 SCROLL CAPS NUM Capture Print echo

```
                              RM @ Tower 1
                      AP Location Info Config Menu
 -==========================================================================-

     A) File Media                     TFTP

     B) TFTP Host Address              192.168.1.2

     C) Transfer Options

     D) AP Locations Filename          ap_locations_pcruiser

     E) Retrieve Text File

     F) Send Text File

     G) View AP Location File



         Select a letter to configure an item, <ESC> for the prev menu
```

Figure 3-30. AP Location Info Configuration Menu, TFTP Mode

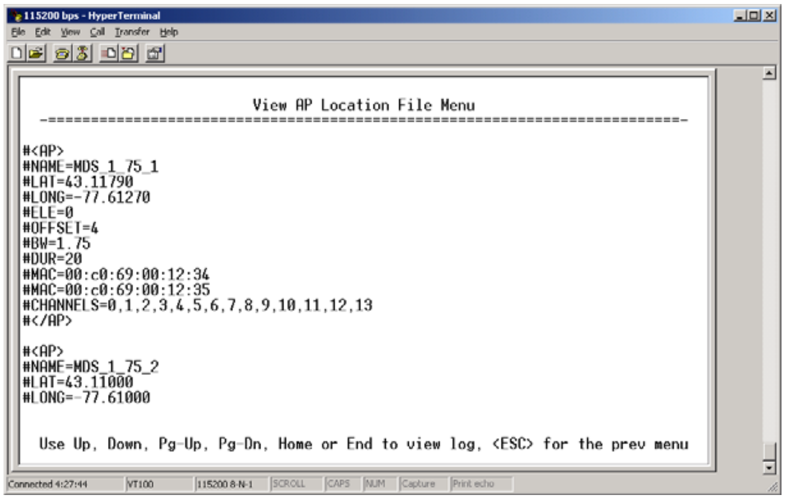


Com1 115200 - HyperTerminal
File Edit View Call Transfer Help

```
                              RM @ Tower 1
                       AP Location Info Config Menu
 -=========================================================================-

   A) File Media                       USB



   D) AP Locations Filename            ap_locations_pcruiser

   E) Retrieve Text File

   F) Send Text File

   G) View AP Location File




        Select a letter to configure an item, <ESC> for the prev menu
```

Figure 3-31. AP Location Info Configuration Menu, USB Mode
(Remote with WiFi only)

- **File Media**—A selection of methods for transferring files to and from the radio available on firmware version 3.0 radios. The options are: **TFTP** and **USB**.
- **TFTP Host Address**—IP address of the TFTP server that holds the AP locations file. [**any valid IP address; 0.0.0.0**]
- **Transfer Options**—Menu for configuring the TFTP transfer.
- **AP Locations Filename**—Name of the AP Locations file on the server. [**any valid filename string; ap_locations.txt**]
- **Auto AP Location Download**—A setting to force connected remotes to download immediately the AP Locations file on the AP. Remotes that associate to an AP with this feature will also download the file.
- **Retrieve Text File**—Download AP Locations text file from the server.
- **Send Text File**—Upload the local AP Locations file to the server.
- **View AP Location File**—Allows on-screen review of the AP Locations file. An example screen is shown in Figure 3-32.



```
                    View AP Location File Menu
  -==========================================================================-

#<AP>
#NAME=MDS_1_75_1
#LAT=43.11790
#LONG=-77.61270
#ELE=0
#OFFSET=4
#BW=1.75
#DUR=20
#MAC=00:c0:69:00:12:34
#MAC=00:c0:69:00:12:35
#CHANNELS=0,1,2,3,4,5,6,7,8,9,10,11,12,13
#</AP>

#<AP>
#NAME=MDS_1_75_2
#LAT=43.11000
#LONG=-77.61000


  Use Up, Down, Pg-Up, Pg-Dn, Home or End to view log, <ESC> for the prev menu
```

Figure 3-32. AP Location Text File

AP Locations File Syntax and Guidelines

The AP Locations file is used by the Remote radio to determine which Access Point to connect to when operating in **Hopping w/ Hand-offs** mode. The AP Locations file is a simple text file containing information about the location and configuration of all Access Points that the Remote can associate with. The file is filled in by creating “AP definition blocks” using tags and labels. The <AP> tag is used to begin a definition block and the </AP> tag ends the block. Within the block, you can declare several parameters using a LABEL=VALUE syntax. The possible labels are:

- **NAME**—The name of the AP. Typically set to the **Device Name** configured on the AP
- **LAT**—GPS Latitude of the AP in decimal degrees
- **LONG**—GPS Longitude of the AP in decimal degrees
- **OFFSET**—Pattern Offset configured on the AP
- **BW**—Bandwidth configured on the AP
- **DUR**—Frame duration (10 or 20) configured on the AP
- **MAC**—The “Wireless MAN Address” configured on the AP
- **CHANNELS**—Specifies which channels are being used by the AP
- **GROUP**—Name of a grouping of Access Points. A Remote configured with **Eth Follows Association** enabled does not disable its wired port when moving between APs of the same group.This is useful when two or more APs are on the same subnet.
- **MODE**—**Single** or **Hopping**. Specifies the Frequency Mode of the AP.
- **SINGLE_CHAN**—Specifies the AP’s Single Frequency mode channel.

The **MAC** label may appear twice if a P23 redundant Access Point is installed at that location. In this case, one **MAC** statement provides the

MAC address of the A radio and the other **MAC** statement provides the MAC address of the B radio. The **CHANNELS** statement only needs to be present if the channel selection feature is used at the Access Point to limit which channels are active. If all channels are used, you can leave out the **CHANNELS** statement. You can leave out the **BW** statement for APs that are configured to 1.75 MHz bandwidth. You can also leave out the **DUR** statement for APs that are configured with a 20 millisecond frame duration.

NOTE: MAC filtering on APs should be used only in a stable network or with the complete understanding that devices not listed in the AP filter will not gain access to the Remotes, nor be accessible to the Remotes.

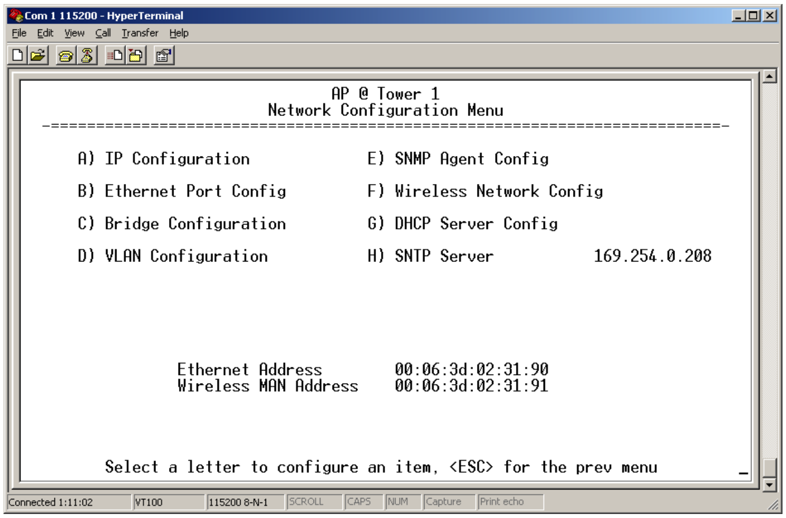
The following shows the syntax of the AP Locations file:

```
# Mercury Remote AP Locations file
# These lines are comments

# The following line defines the beginning of an AP definition block
<AP>
NAME=MyAccessPoint
LAT=43.11790
LONG=-77.61270
OFFSET=3
BW=1.75
DUR=20
MAC=00:06:3D:00:01:23
CHANNELS=1,3,5,7,9,11,13

# The following line defines the end of the AP definition block
</AP>
```

3.4.6 SNTP Server Configuration

The Simple Network Time Protocol (SNTP) allows the Mercury to obtain time of day data from a network server.

NOTE: The Mercury can also obtain time of day data from the GPS receiver, if the receiver has a satellite fix.



```
                              AP @ Tower 1
                       Network Configuration Menu
-==========================================================================-

     A) IP Configuration              E) SNMP Agent Config

     B) Ethernet Port Config          F) Wireless Network Config

     C) Bridge Configuration          G) DHCP Server Config

     D) VLAN Configuration            H) SNTP Server          169.254.0.208



                Ethernet Address        00:06:3d:02:31:90
                Wireless MAN Address    00:06:3d:02:31:91


        Select a letter to configure an item, <ESC> for the prev menu
```

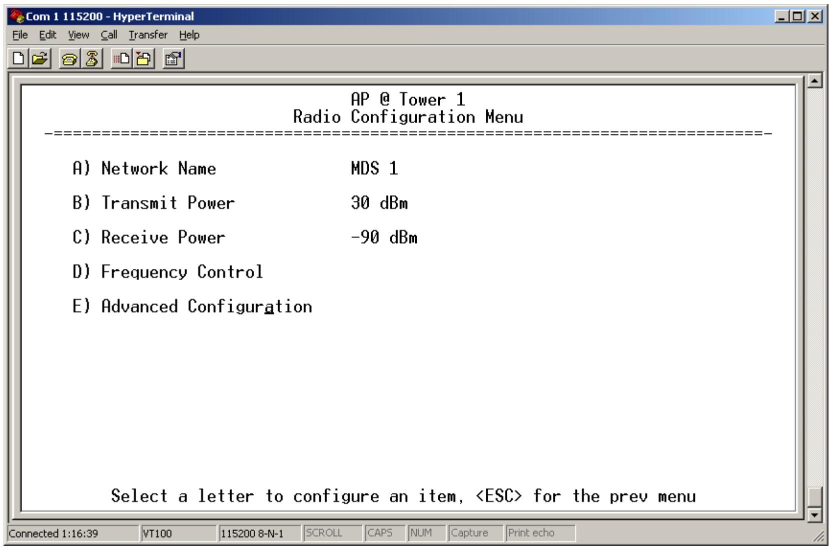
Figure 3-33. SNTP Server Entry (on Network Configuration Menu)

When **SNTP Server** is selected (item H), the area to the right of the parameter becomes active, allowing you to enter a valid SNTP server address. Press the Return key to make the address entry active.

3.5 RADIO CONFIGURATION

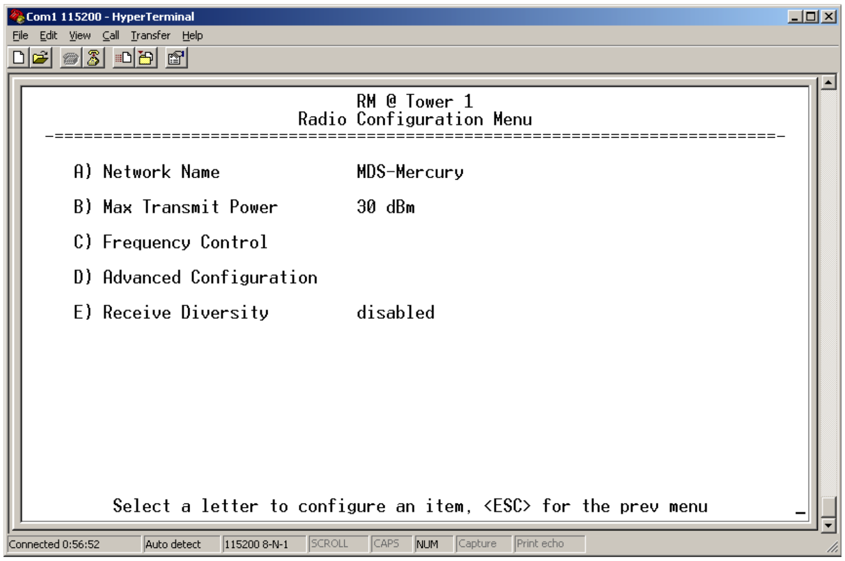
There are two primary layers in the transceiver network—radio and data. Since the data layer is dependent on the radio layer working properly, configure and set the radio items before proceeding. This section explains the *Radio Configuration Menu*, (Figure 3-34 for AP, Figure 3-35 for Remote).

3.5.1 Radio Configuration Menu



```
                              AP @ Tower 1
                        Radio Configuration Menu
-==========================================================================-

     A) Network Name                MDS 1

     B) Transmit Power              30 dBm

     C) Receive Power               -90 dBm

     D) Frequency Control

     E) Advanced Configuration



        Select a letter to configure an item, <ESC> for the prev menu
```

Figure 3-34. Radio Configuration Menu
(From Access Point)



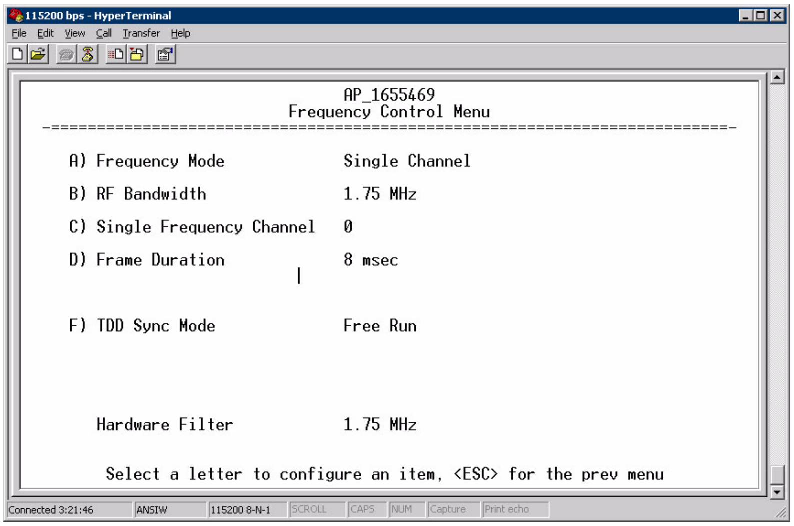
```
                              RM @ Tower 1
                        Radio Configuration Menu
-============================================================================

    A) Network Name                MDS-Mercury

    B) Max Transmit Power          30 dBm

    C) Frequency Control

    D) Advanced Configuration

    E) Receive Diversity           disabled








       Select a letter to configure an item, <ESC> for the prev menu
```

Figure 3-35. Radio Configuration Menu

- **Network Name**—The user-defined name for the wireless network. [**Any 40 character string; MDS-Mercury**]
- **Transmit Power** (AP Only)—Sets/displays RF power output level in dBm. This setting should reflect local regulatory limitations and losses in antenna transmission line. (See *“How Much Output Power Can be Used?”* on Page 171 for information on how to calculate this value.) [**0—30; 30**(900 model)] [**0—23; 23**(3650 model)]
- **Max Transmit Power** (Remote Only)—Sets/displays maximum RF power output level in dBm of the Remote. Power level is still controlled by the AP, but it is limited to the maximum level set here. This setting should reflect local regulatory limitations and losses in antenna transmission line. (See *“How Much Output Power Can be Used?”* on Page 171 for information on how to calculate this value.) [**0—30; 30**(900 model) **0—23; 23**(3650 model)
- **Receive Power** (AP Only)—View/set the receiver gain setpoint for the expected strength of incoming signals from Remotes. This setting indicates at what level (in dBm) the AP expects to hear the Remote stations. A setting of -70 would set the AP receiver’s gain to a relatively low level, while a setting of -85 would be a comparatively high gain setting. [**-100 to -20; -75**]
- **Frequency Control**—Opens a submenu where you can view or set frequency mode bandwidth, channel and other parameters as described in *Frequency Control Menu* below.
- **Advanced Configuration**—Opens a submenu where you can view or set modulation, protection/hysteresis margins, data compression, ARQ settings, and other parameters as described in *Advanced Configuration Menu* on Page 75.
- **Receive Diversity** (900 MHz Remote Only)—Allows enabling or disabling the RX2 antenna port for receive operation. The use of two antennas allows “diversity” reception which helps minimize the effects of fading due to multipath reception of signals.

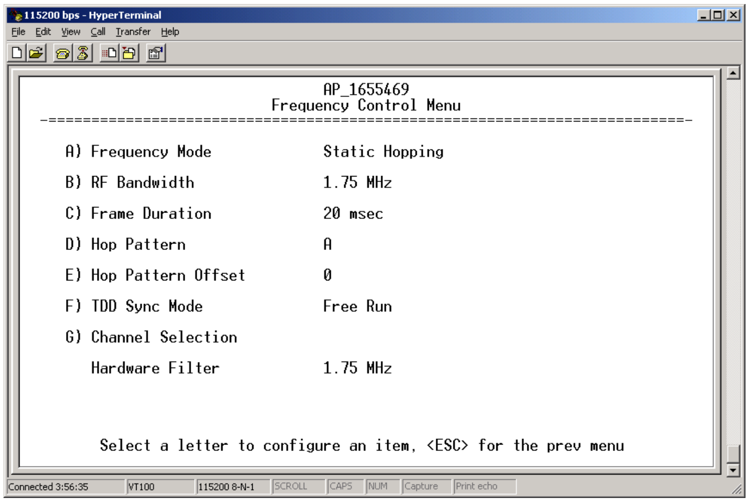
Frequency Control Menu

The items shown on this menu vary depending on the Frequency Mode Selection (**Single Channel**, **Static Hopping**, **Hopping w/Hand-offs**). Examples of all three screens are provided below, followed by a description of the menu items.



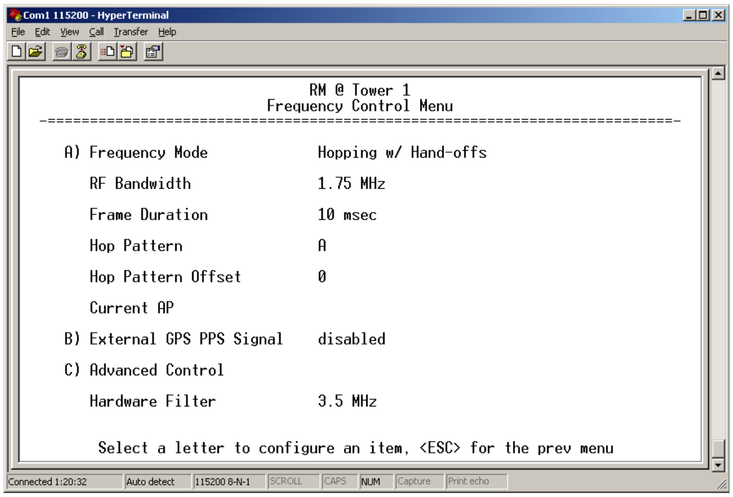
```
                                 AP_1655469
                           Frequency Control Menu
-==========================================================================-

   A) Frequency Mode              Single Channel

   B) RF Bandwidth                1.75 MHz

   C) Single Frequency Channel    0

   D) Frame Duration              8 msec


   F) TDD Sync Mode               Free Run



      Hardware Filter             1.75 MHz

       Select a letter to configure an item, <ESC> for the prev menu
```

Figure 3-36. Frequency Control Menu
(900 MHz AP, Single Channel Freq. Mode)



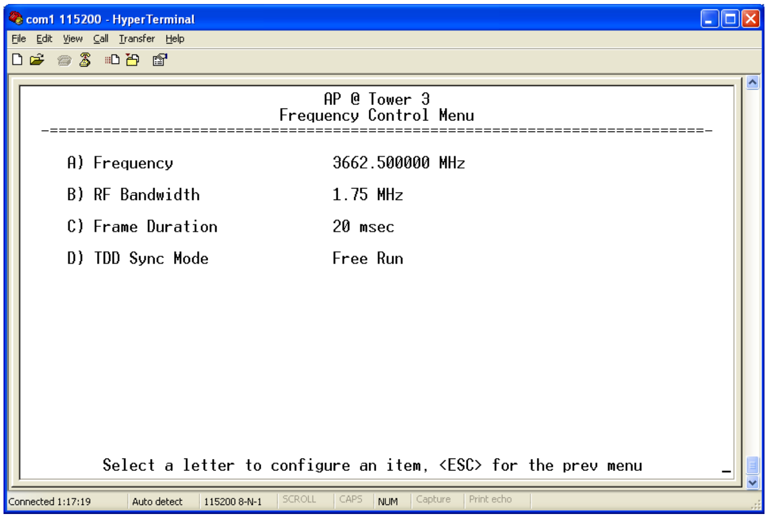
```
                                 AP_1655469
                           Frequency Control Menu
-==========================================================================-

   A) Frequency Mode              Static Hopping

   B) RF Bandwidth                1.75 MHz

   C) Frame Duration              20 msec

   D) Hop Pattern                 A

   E) Hop Pattern Offset          0

   F) TDD Sync Mode               Free Run

   G) Channel Selection

      Hardware Filter             1.75 MHz


       Select a letter to configure an item, <ESC> for the prev menu
```

Figure 3-37. Frequency Control Menu
(900 MHz AP, Static Hopping Freq. Mode)



```
                                RM @ Tower 1
                           Frequency Control Menu
-===========================================================================-

   A) Frequency Mode              Hopping w/ Hand-offs

      RF Bandwidth                1.75 MHz

      Frame Duration              10 msec

      Hop Pattern                 A

      Hop Pattern Offset          0

      Current AP

   B) External GPS PPS Signal     disabled

   C) Advanced Control

      Hardware Filter             3.5 MHz

       Select a letter to configure an item, <ESC> for the prev menu
```

Figure 3-38. Frequency Control Menu
(900 MHz Remote, Hopping w/Hand-offs Freq. Mode)



```
                                AP @ Tower 3
                           Frequency Control Menu
-===========================================================================-

   A) Frequency                     3662.500000 MHz

   B) RF Bandwidth                  1.75 MHz

   C) Frame Duration                20 msec

   D) TDD Sync Mode                 Free Run



       Select a letter to configure an item, <ESC> for the prev menu
```

Figure 3-39. Frequency Control Menu
(Mercury 3650 model only)

- **Frequency** (Mercury 3650 only)—Used to set/display the radio's operating frequency. MDS 3650 radios do not employ frequency hopping, thus the entry here is a specific RF operating channel. The allowable entry range is **3652.000** to **3673.000** MHz.
- **Frequency Mode**—The unit can operate on one selected frequency or frequency hop. Remotes have the option of using a static hopping configuration or using the AP locations file to select an AP and perform hand-offs. For more information on hand-offs, see Table 3-2 on Page 73. Changing this parameter requires a radio reboot.
  [Static Hopping, Hopping with Hand-offs, Single Channel; Single Channel]

NOTE: Frequency Mode Static Hopping on Access Points requires TDD Sync Mode GPS Required.

Channel/Frequency Allocations for Single Channel 900 MHz are shown in Table 3-1. The transceiver uses up to 14 channels (0-13) depending on the bandwidth used (1.75 MHz or 3.5 MHz).

Table 3-1. Channel/Frequency Allocations

Channel	1.75 MHz B/W	3.5 MHz B/W
0	903.000000	904.000000
1	904.800000	907.600000
2	906.600000	911.400000
3	908.600000	915.000000
4	910.400000	918.600000
5	912.200000	922.400000
6	914.000000	926.000000
7	916.000000	
8	917.800000	
9	919.600000	
10	921.400000	
11	923.400000	
12	925.200000	
13	927.000000	

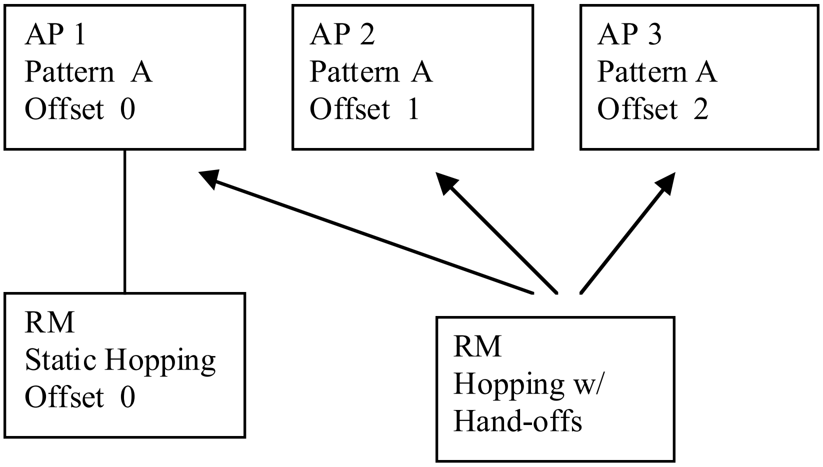
- **RF Bandwidth**—View/set the radio's RF operating bandwidth. Radios are factory-configured for either 1.75 MHz or 3.5 MHz maximum bandwidth. Determine the factory configuration of a radio by viewing the "CONFIG" number on the label at the bottom of the radio. 1.75 MHz units will have a Configuration string starting with HGA/R9N1, and 3.5 MHz units will have a string starting with HGA/R9N3.

  The bandwidth setting on this menu does not necessarily have to match the configured bandwidth of the radio, but it is limited by it. That is, you can set a 3.5 MHz radio to either 1.75 or 3.5, but you can only set a 1.75 MHz radio to 1.75. Note that setting a 3.5 MHz bandwidth radio to operate at 1.75 MHz bandwidth will cause a slight degradation of interference rejection capability. Note that this parameter is read-only when **Frequency Mode** is set to **Hopping w/Hand-offs**. [**1.75MHz, 3.5MHz**]

  The Mercury 3650 can operate at 1.75 MHz, 3.5 MHz, 5 MHz, or 7 MHz bandwidth. The unit uses a digital filter so that any unit can operate at any bandwidth.

- **Single Frequency Channel**—The RF frequency that the integrated radio will operate on when in single frequency (non-hopping) mode. [**0 to 6 for 3.5-MHz, 0 to 13 for 1.75-MHz; 0**].
- **Frame Duration**—Defines the over-the-air media access control framing. Note that this parameter is read-only when **Frequency Mode** is set to **Hopping w/Hand-offs**. [**5, 8, 10, or 20 msec; 20 msec**]
- **Hop Pattern**—Selects a pre-defined series of channels that is followed when hopping. Note that this parameter is read-only when **Frequency Mode** is set to **Hopping w/Hand-offs**.
- **Hop Pattern Offset**—Inserts an offset into the hop pattern that is synchronized with the GPS. For example, if the offset is 0, the start of the pattern is aligned with the GPS timing. If the offset is 3, then the fourth hop of the pattern is aligned with the GPS timing. All of the APs that are part of a network should use the same pattern and each one should have its own offset.

  In the diagram below, one Remote is configured for static hopping and will only associate with AP1 because they are both using Offset 0. The hand-off configured Remote, using its AP Locations file, may connect to AP1, AP2, or AP3. The Remote does this by determining the Offset for each AP, then configuring its radio.



- **Current AP** (Remote only)—Shows the name of the AP that the Remote is trying to associate with. Note that this parameter is read-only when **Frequency Mode** is set to **Hopping w/Hand-offs**.

- **TDD Sync Mode** (AP only)—Indicates if the Access Point's transmissions should synchronize with the GPS timing. Configure this parameter to **GPS Required** when the AP is configured for **Static Hopping**. TDD Sync Mode (Time-Division Duplex) is useful in eliminating same-network interference for multiple-AP installations. When enabled, all AP transmissions are synchronized using GPS timing information. The result is that no AP transmits while another is receiving, which prevents AP-to-AP interference. Changing this parameter requires a radio reboot. [**Free Run, GPS Required; Free Run**] *Note: Do not use the **Prefer GPS** setting.*

- **Channel Selection** (AP only)—Opens a submenu where you can specify channel usage.
- **External GPS PPS Signal**—Indicates whether or not an external Pulse Per Second (PPS) signal is available. The setting may be changed by pressing the spacebar after selection of the menu item. This allows the radio to use the proper timing scheme when frequency hopping.
- **Advanced Control** (Remote only)—Brings up a submenu (see Figure 3-40) where additional communication parameters may be set.
- **Hardware Filter** (900 MHz only)—This field provides a read-only indication of the maximum bandwidth of the radio. [**1.75 MHz or 3.5 MHz**]

Hand-Off Mode Parameters

In a mobile or portable application, a Remote radio can move and associate with different APs depending on its location. The process by which the Remote ends the connection with one AP and begins a connection with another AP is called "hand-off." Table 3-2 lists the hand-off parameters for Remote transceivers and explains how they operate under different signal conditions.

Table 3-2. Remote Hand-Off Parameters

	Strict Distance	**Strict Connection**	**Strict Signal**	**Signal and Distance**	**Signal, Distance, and Bearing**
Description	The Remote always chooses the closest AP regardless of connection status, RSSI, etc.	The Remote will only choose a new AP when the modem link is lost.	The Remote chooses a new AP when the modem link is lost or when the RSSI or SNR falls below the threshold. The Remote then chooses the closest AP.	Operates the same way as the Strict SIgnal method except that the current AP is abandoned only if the next AP is within the distance threshold.	Operates the same way as the Signal and Distance method except that the current AP is abandoned only if the bearing is away from the current AP.
AP(s) Used (see note below Table 3-2)	Only closest AP.	Closest 3 APs.	Closest 3 APs.	Closest 3 APs; AP must be within Distance Threshold.	Closest 3 APs; AP must be within Distance Threshold.
Max. Scanning Seconds	N/A	Applicable	Applicable	Applicable	Applicable

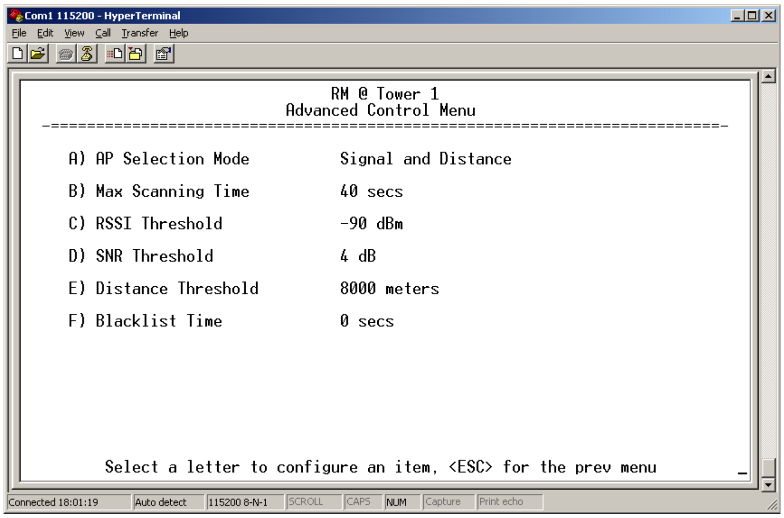
Table 3-2. Remote Hand-Off Parameters

	Strict Distance	Strict Connection	Strict Signal	Signal and Distance	Signal, Distance, and Bearing
RSSI Threshold	N/A	N/A	Applicable	Applicable	Applicable
SNR Threshold	N/A	N/A	Applicable	Applicable	Applicable
Distance Threshold	N/A	N/A	N/A	Applicable	Applicable
Blacklist Time	N/A	Applicable	Applicable	Applicable	Applicable

NOTE: In Table 3-2 above, modes using the "Closest 3 APs" first attempt to connect to the closest AP. If after the maximum number of scanning seconds (**Max. Scanning Seconds**) a link is not established, then the next closest AP is chosen. If after another maximum number of scanning seconds a link is not established, then the third closest AP is chosen. If a link still is not established, the Remote again chooses the closest AP and continues this cycle until it is associated to one of the APs.

NOTE: In Table 3-2 above, modes which use the **RSSI** and **SNR Thresholds** use them in an "or" logic fashion. That is, if the RSSI is below the set threshold OR the SNR is below threshold, the Remote drops the current AP.

Advanced Control Menu



```
                              RM @ Tower 1
                          Advanced Control Menu
 -==========================================================================-

     A) AP Selection Mode          Signal and Distance

     B) Max Scanning Time          40 secs

     C) RSSI Threshold             -90 dBm

     D) SNR Threshold              4 dB

     E) Distance Threshold         8000 meters

     F) Blacklist Time             0 secs




        Select a letter to configure an item, <ESC> for the prev menu
```

Figure 3-40. Advanced Control Menu
(Hopping with Handoff Mode, Remote Only)

AP Selection Mode—The method used by the Remote to determine what AP to connect to. It may be based on **Signal**, **Distance and Bearing** (from the AP's GPS coordinates in the AP locations file), or **Connection.** Table 3-2 on Page 73 summarizes these parameters and other selections on this menu.

Max Scanning Time—The maximum time to try to connect to an AP before trying the next one in the AP Locations file.

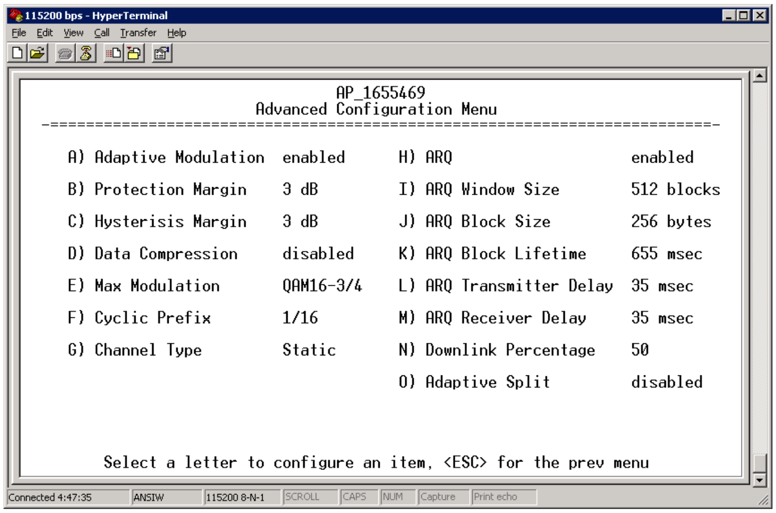
RSSI Threshold—The RSSI cutoff for **Signal** modes. When the RSSI drops below this value, the Remote disconnects and looks for a new AP.

SNR Threshold—The SNR cutoff point for **Signal** modes. When the SNR drops below this value, the Remote disconnects and looks for a new AP.

Distance Threshold—The distance cutoff when operating in Distance mode. When the Remote's AP gets farther away than this distance, it disconnects and look for a new AP.

Blacklist Time—The amount of time (in seconds) that an AP is ignored when the Remote is trying to find a better connection.

Advanced Configuration Menu



```
                              AP_1655469
                     Advanced Configuration Menu
 ==========================================================================

    A) Adaptive Modulation  enabled      H) ARQ                    enabled

    B) Protection Margin    3 dB         I) ARQ Window Size        512 blocks

    C) Hysterisis Margin    3 dB         J) ARQ Block Size         256 bytes

    D) Data Compression     disabled     K) ARQ Block Lifetime     655 msec

    E) Max Modulation       QAM16-3/4    L) ARQ Transmitter Delay  35 msec

    F) Cyclic Prefix        1/16         M) ARQ Receiver Delay     35 msec

    G) Channel Type         Static       N) Downlink Percentage    50

                                         O) Adaptive Split         disabled



        Select a letter to configure an item, <ESC> for the prev menu
```

Figure 3-41. Advanced Configuration Menu

- **Adaptive Modulation**—Enables automatic selection of modulation and FEC rate based on SNR. [**enabled, disabled; enabled**]
- **Protection Margin**—A number of decibels of SNR added to the minimum SNR required for a given modulation and FEC rate. See *"Modulation Protection and Hysteresis Margins"* on Page 77 for more information. [**0-50; 3**]
- **Hysteresis Margin**—A number of decibels of SNR added to the maximum SNR required before shifting to the next higher modulation and FEC rate. See *"Modulation Protection and Hysteresis Margins"* on Page 77 for more information. [**0-50; 3**]
- **Data Compression**—This setting determines whether over-the-air data packets will be compressed. [**enabled, disabled; enabled**]

- **Max Modulation**—Sets the highest modulation speed the transceiver will use.
  [**BPSK, QPSK-1/2, QPSK-3/4, 16QAM-1/2, 16QAM-3/4, 64QAM-2/3; QAM16-3/4**]
- **Cyclic Prefix** (AP only)—Amount of additional information added to the over-the-air packets to mitigate the effects of channel multipath. [**1/4, 1/8, 1/16,1/32; 1/16**]
- **Channel Type** (AP only)—This parameter, available on Access Point units, must be set appropriately according to the signal conditions of a network. For installations with strong signals, low interference, and minimal fading, set the Channel Type parameter to **Static**. This setting is generally appropriate for Access Points whose Remotes are in fixed locations. It supports a large offered payload with high packet rates.

  For installations with significant interference and fading or nomadic/mobile Remotes, set the Channel Type parameter to **Dynamic.** [**Static, Dynamic; Static**]
- **ARQ** (AP only)—Enables the Automatic Repeat Request function.
  [**enable, disable; enabled**]
- **ARQ Window Size** (AP only)—The maximum number of blocks to send before receiving an acknowledgement. [**1—1024; 512**]
- **ARQ Block Size** (AP only)—ARQ is applied to payload data in blocks of this size. [**4—2040; 256**]
- **ARQ Block Lifetime** (AP only)—ARQ blocks are valid for this length of time. [**0—655; 655**]
- **ARQ Transmitter Delay** (AP only)—The length of time the transmitter waits before repeating an unacknowledged packet.
  [**1—655; 35**]
- **ARQ Receiver Delay** (AP only)—The length of time the receiver waits before repeating an unacknowledged packet. [**1—655; 35**]
- **Downlink Percentage** (AP only)—The percentage of link time given to downstream traffic. It should be set to **50%** when **Adaptive Split** is set to **enabled.** [**10-90%; 50%**]
- **Adaptive Split** (AP only)—The adaptive split feature provides improved link utilitization and throughput for burst payload traffic. The Mercury is a TDD system and normally allocates 50% of its capacity to the downlink and 50% to the uplink. When adaptive split is enabled, the Media Access Controller (MAC) in the Access Point monitors the traffic flow continuously in the downlink and uplink directions. The MAC automatically modifies the downlink split in response to the traffic load. When more traffic is flowing upstream, the downlink split changes to allocate additional capacity to the uplink. When more traffic is flowing downstream, the downlink gets additional capacity. If TDD synchronization is used to synchronize Access Points and minimize inter-Access Point interference, Adaptive Split should be disabled. [**enabled, disabled; enabled**]

Modulation Protection and Hysteresis Margins

Table 3-3 on Page 77 shows the relationship between the radio's Protection Margin, Hysteresis Margin, and the SNR range allowed for each form of modulation.

Column A lists the available modulation types for the radio, while columns B and C show the minimum SNR range required to operate in each modulation. For example, an SNR of 5.8 dB in Column B is required for QPSK modulation with an FEC rate of 1/2. An SNR of 8.4 dB is required for QPSK modulation with an FEC rate of 3/4.

Columns B and C have a Hysteresis Margin of 0 dB. This means there is no overlap between the maximum SNR for BPSK (5.8 dB) and the minimum SNR for QPSK-1/2 (5.8 dB).

Columns D and E show the SNR ranges with a Protection Margin and Hysteresis Margin of 3 dB. The Protection Margin is added to each value in Columns B and C to get the corresponding value in Columns D and E. The Hysteresis Margin is then *added* to the Max SNR value.

For example, the third SNR value in Column D is 11.4 dB (8.4 + 3 = 11.4 dB), and the third SNR value in Column E is 17.1 (11.1 + 3 + 3 = 17.1 dB). Note that with a Hysteresis Margin of 3 dB, there is an overlap of 3 between the Max SNR of one modulation and the Min SNR of the next higher modulation.

In this case, if a link is operating with an SNR of 15 dB, then QPSK-3/4 modulation is used. The SNR must go above 17.1 dB before the link shifts up to 16QAM-1/2 modulation. Conversely, the SNR will need to drop below 11.4 dB before the link shifts down to QPSK-1/2.

The blank entries (--) in the table indicate infinite SNR (*i.e.*, the top of the range). For example, in columns B and C, 64QAM-3/4 modulation is used for all SNR values from 20 dB and up.

Table 3-3. Adaptive Modulation Protection and Hysteresis Margins

A	B	C	D	E	F	G
	Protection	**0**	**Protection**	**3**	**Protection**	**5**
	Hysteresis	**0**	**Hysteresis**	**3**	**Hysteresis**	**3**
	Min SNR	**Max SNR**	**Min SNR**	**Max SNR**	**Min SNR**	**Max SNR**
BPSK	3.3	5.8	3.3	11.8	3.3	13.8
QPSK-1/2	5.8	8.4	8.8	14.4	10.8	16.4
QPSK-3/4	8.4	11.1	11.4	17.1	13.4	19.1
16QAM-1/2	11.1	14.4	14.1	20.4	16.1	22.4
16QAM-3/4	14.4	18.4	17.4	24.4	19.4	26.4
64QAM-2/3	18.4	20	21.4	26	23.4	28
64QAM-3/4	20	--	23	--	25	--

3.5.2 Serial Port Configuration

Overview

The transceiver includes an embedded serial device server that provides transparent encapsulation over IP. In this capacity, it acts as a gateway between serial and IP devices. Two common scenarios are PC applications using IP to talk to remote devices, and serial PC applications talking to remote serial devices over an IP network. These data services are available from the COM1 port of the radio.

***COM1 Port**—Dual Purpose Capability*

The COM1 port is used as a local console connection point and to pass serial data with an external device. Setting the COM1 port status to **Enable** prevents access to the Management System (MS) through this port. However, the MS can still be accessed via the LAN port using Telnet or a web browser.

NOTE: To restore the COM1 port to support Management System services, connect a terminal to the port, select the proper baud rate (115,200 is default), and enter an escape sequence (**+++**) to reset it to the console mode.

There is a configuration parameter for the **console baud rate** and another parameter for the **serial data baud rate**. These items can be different, so when switching out of data mode to console mode, the port might also change its baud rate.

TCP vs. UDP

TCP and UDP services are used by the transceiver’s embedded serial device server. TCP provides a connection-oriented link with end-to-end acknowledgment of data, but with some added overhead. UDP provides a connectionless best-effort delivery service with no acknowledgment.

Most polled protocols are best served by UDP service as the protocol itself has built-in error recovery mechanisms. UDP provides the needed multidrop operation by means of multicast addressing.

On the other hand, TCP services are best suited for applications without a recovery mechanism (error-correction) and must have the guaranteed delivery that TCP provides in spite of the extra overhead. The *IP-to-Serial Application Example* on Page 85 shows how to do this.

Serial Encapsulation

Transparent encapsulation, or IP tunneling, provides a mechanism to encapsulate serial data in an IP envelope. All bytes received through the serial port are put into the data portion of a TCP or UDP packet (TCP or UDP are user-configurable options). In the same manner, all data bytes received in a TCP or UDP packet are output through the serial port.

When the radio receives data through the serial port, it is buffered until the packet is received completely. There are two events that signal an end-of-packet to the radio: a period of time since the last byte was received, or a number of bytes that exceed the buffer size. Both of these triggers are user-configurable.

One radio can perform serial data encapsulation (IP-to-Serial) and talk to a PC. You can use two radios together (or one radio and a terminal server) to provide a serial-to-serial channel. For more information, see *"IP-to-Serial Application Example"* on Page 85 and *Point-to-Point Serial-to-Serial Application Example* on Page 85.

TCP Client vs. TCP Server

On a TCP session there is a server side and a client side. You can configure the transceiver to act as either a server or a client. The server always waits for requests from clients.

The client mode attempts to establish a connection to a server (typically running on a PC) whenever it receives data on the serial port. There is also a Client/Server mode, where the client establishes a connection when data is received on the serial port and the server is not currently handling a connection.

UDP Multicast

IP provides a mechanism to perform a limited broadcast to a specific group of devices. This is known as *multicast addressing*. Multicast addressing requires the use of a specific branch of IP addresses set apart by the Internet Assigned Numbers Authority (IANA) for this purpose.

UDP multicast is generally used to transport polling protocols typically used in SCADA applications where multiple remote devices will receive and process the same poll message.

As part of the Multicast implementation, the radio sends IGMP membership reports and IGMP queries, and responds to membership queries. It defaults to V2 membership reports, but responds to both V1 and V2 queries.

The *Point-to-Multipoint Serial-to-Serial Application Example* on Page 86 shows how to provide multicast services.

Data Buffering

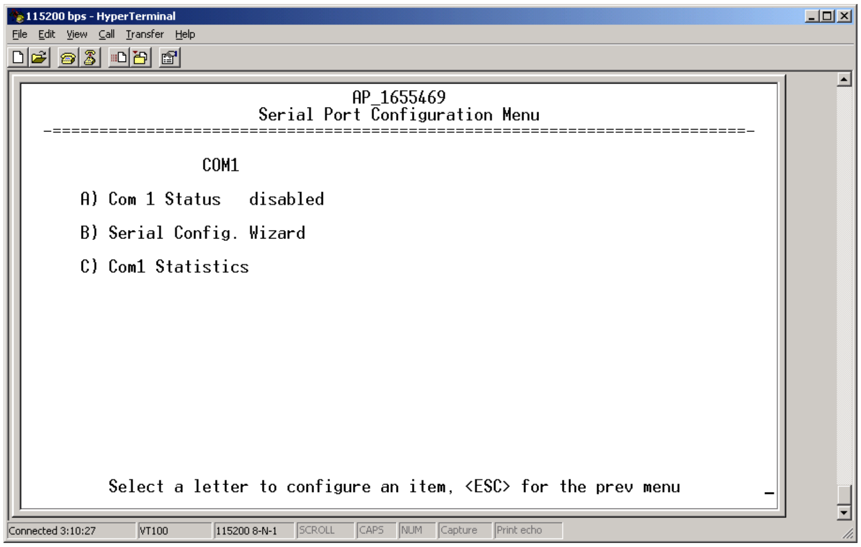
Data buffering is always active regardless of the selected mode. If you connect EIA-232 serial devices to the transceiver, review these parameters carefully.

Serial Configuration Wizard

GE MDS recommends the Serial Configuration Wizard, available through the **Serial Port Configuration Menu**, for configuration of the serial terminal services. The wizard uses a step-by-step process, eliminates possible conflicting settings, and streamlines complex configurations.

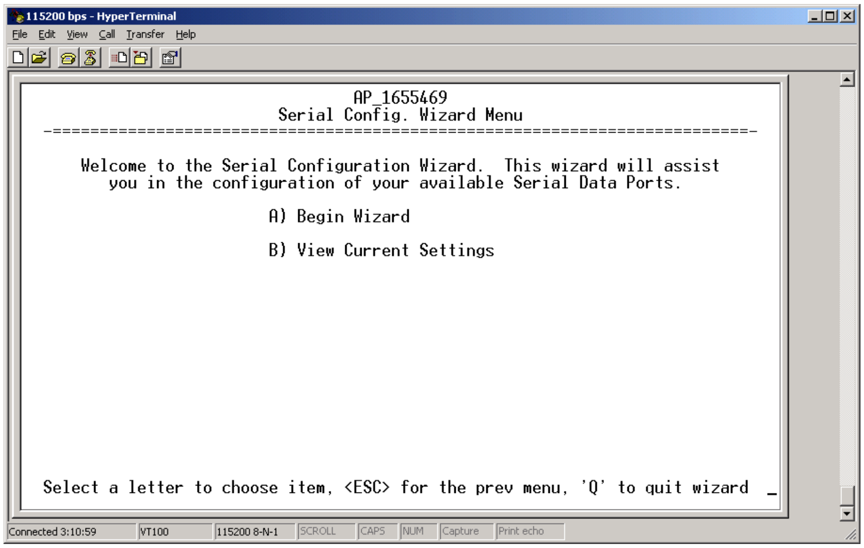
You can bypass the wizard by selecting option **B) View Current Settings** and adjusting the individual settings of the appropriate parameter.

Serial Port Configuration Menu



```
                               AP_1655469
                       Serial Port Configuration Menu
 -==========================================================================-

                  COM1

     A) Com 1 Status   disabled

     B) Serial Config. Wizard

     C) Com1 Statistics




        Select a letter to configure an item, <ESC> for the prev menu
```

Figure 3-42. Serial Port Configuration Menu

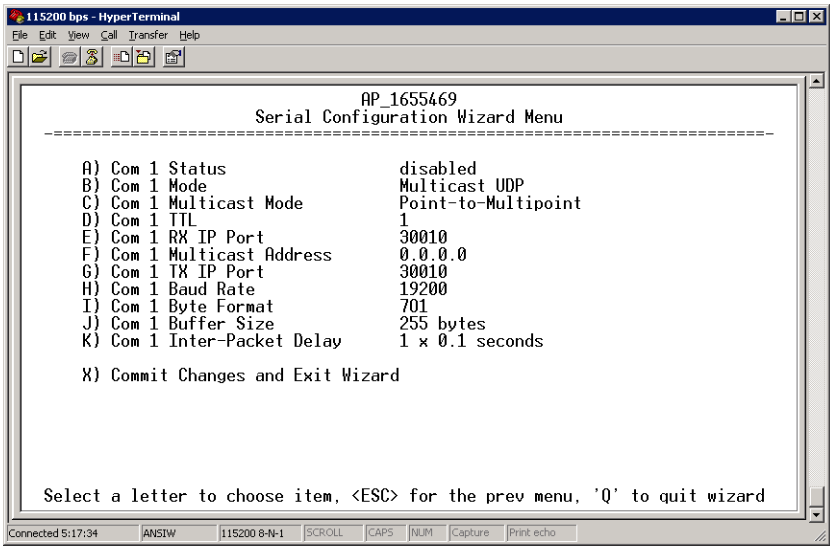


```
                               AP_1655469
                         Serial Config. Wizard Menu
 -==========================================================================-

     Welcome to the Serial Configuration Wizard.  This wizard will assist
        you in the configuration of your available Serial Data Ports.

                         A) Begin Wizard

                         B) View Current Settings




 Select a letter to choose item, <ESC> for the prev menu, 'Q' to quit wizard
```

Figure 3-43. Serial Configuration Wizard

- **Begin Wizard**—Tool for configuring serial ports using a step-by-step process.
- **View Current Settings**—Displays all setable options. Varies depending on the selected IP protocol.

Configuring for UDP Point-to-Multipoint



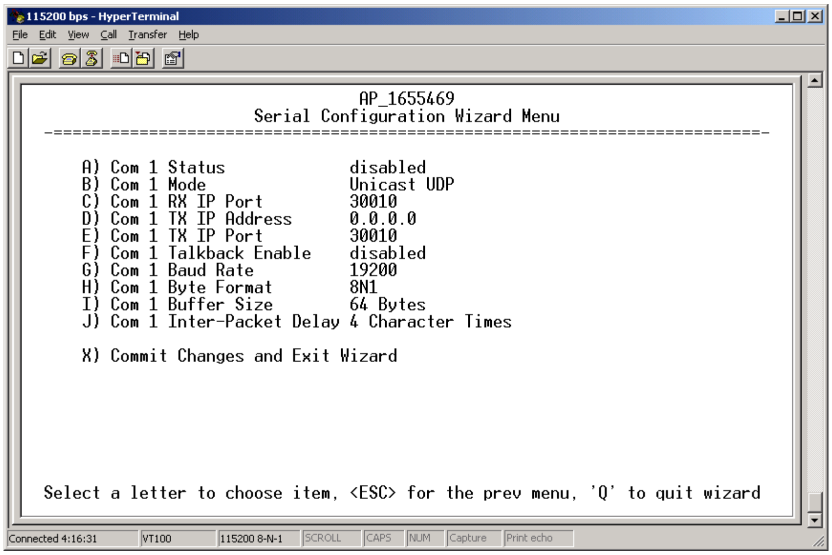
```
                              AP_1655469
                    Serial Configuration Wizard Menu
 -==========================================================================-

      A) Com 1 Status                 disabled
      B) Com 1 Mode                   Multicast UDP
      C) Com 1 Multicast Mode         Point-to-Multipoint
      D) Com 1 TTL                    1
      E) Com 1 RX IP Port             30010
      F) Com 1 Multicast Address      0.0.0.0
      G) Com 1 TX IP Port             30010
      H) Com 1 Baud Rate              19200
      I) Com 1 Byte Format            7O1
      J) Com 1 Buffer Size            255 bytes
      K) Com 1 Inter-Packet Delay     1 x 0.1 seconds

      X) Commit Changes and Exit Wizard




 Select a letter to choose item, <ESC> for the prev menu, 'Q' to quit wizard
```

Figure 3-44. UDP Point-to-Multipoint Menu

Use UDP point-to-multipoint to send a copy of the same packet to multiple destinations, such as in a polling protocol.

- **Status**—Enable/Disable the serial data port.
- **Mode**—The type of IP port offered by the transceiver's serial device server. [**TCP, UDP; TCP**]
- **RX IP Port**—Receive IP data from this source and pass it through to the connected serial device. The port number must be used by the application connecting to local TCP or UDP socket. [**Any valid IP port; 30010**]
- **TX IP Address** (used instead of **Local IP Address** when using UDP Point-to-Multipoint)— Configure with a valid Multicast address (224.0.0.0–239.255.255.255). IP packets received with a matching destination address are processed by this unit. [**Any legal IP address; 0.0.0.0**]
- **TX IP Port** (used instead of **Local IP Port** when using UDP Point-to-Multipoint)—This port number must match the number used by the application connecting to local TCP or UDP socket. [**1-64,000; 30010**]
- **Baud Rate**—Data rate (payload) for the COM port, in bits-per-second. [**1,200—115,200; 19200**]
- **Byte Format**—Formatting of data bytes, representing data bits, parity and stop bits. [**7N1, 7E1, 7O1, 8N1, 8E1, 8O1, 8N1, 7N2, 7E2, 7O2, 8N2, 8E2, 8O2; 8N1**]
- **Buffer Size**—Maximum amount of characters that the Remote end buffers locally before transmitting data through the serial port. [**1—255; 255**]
- **Inter-Packet Delay**—Amount of time that signal the end of a message, measured in tenths of a second. [**default = 1 (that is, 1/10th of a second)**]

- **Commit Changes and Exit Wizard**—Save and execute changes made on this screen (shown only after changes have been entered).



```
                              AP_1655469
                     Serial Configuration Wizard Menu
 -=========================================================================-

      A) Com 1 Status             disabled
      B) Com 1 Mode               Unicast UDP
      C) Com 1 RX IP Port         30010
      D) Com 1 TX IP Address      0.0.0.0
      E) Com 1 TX IP Port         30010
      F) Com 1 Talkback Enable    disabled
      G) Com 1 Baud Rate          19200
      H) Com 1 Byte Format        8N1
      I) Com 1 Buffer Size        64 Bytes
      J) Com 1 Inter-Packet Delay 4 Character Times

      X) Commit Changes and Exit Wizard




 Select a letter to choose item, <ESC> for the prev menu, 'Q' to quit wizard
```

Figure 3-45. UDP Point-to-Point Menu

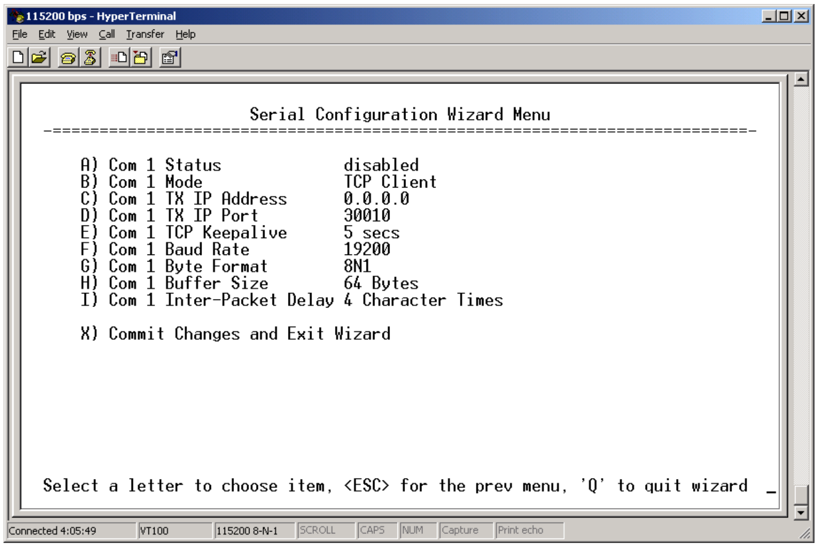
Configuring for UDP Point-to-Point

Use UDP point-to-point configuration to send information to a single device.

- **Status**—Enable/Disable the serial data port.
- **Mode**—UDP Point-to-Point. This is the type of IP port offered by the transceiver's serial device server.
  [**TCP, UDP; TCP**]
- **RX IP Port**—Port number where data is received and passed through to the serial port. The application connecting to this transceiver must use this port number.
  [**1—64,000; 30010**]
- **TX IP Address**—Data received through the serial port is sent to this IP address. To reach multiple Remotes in the network, use UDP Point-to-Multipoint.
  [**Any legal IP address; 0.0.0.0**]
- **TX IP Port**—The destination IP port for data packets received through the serial port on the transceiver.
  [**1—64,000; 30010**]
- **Talkback Enable**—Talkback is a mode where the radio returns a serial message received within a time-out period back to the last address of an incoming UDP message. If the time-out expires, the unit sends the serial data to the configured address. [**Enable, Disable; Disabled**]
- **Baud Rate**—Data rate (payload) for the COM port, in bits-per-second. [**1,200—115,200; 19200**]
- **Byte Format**—Formatting of data bytes. Data bits, parity and stop bits. [**7N1, 7E1, 7O1, 8N1, 8E1, 8O1, 8N1, 7N2, 7E2, 7O2, 8N2, 8E2, 8O2; 8N1**]

- **Buffer Size**—Maximum amount of characters that the Remote end buffers locally before transmitting data through the serial port. [**1—255; 255**]
- **Inter-Packet Delay**—Amount of time that signal the end of a message, measured in tenths of a second. [**default = 1** (that is, 1/10th of a second)]
- **Commit Changes and Exit Wizard**—Save and execute changes made on this screen (shown only after changes have been entered).

Configuring for TCP Mode

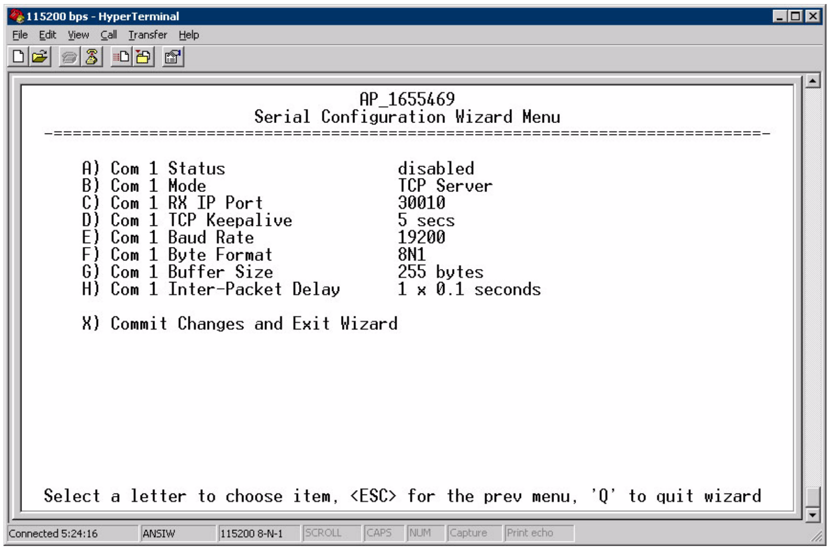


```
                         Serial Configuration Wizard Menu
-============================================================================-

    A) Com 1 Status               disabled
    B) Com 1 Mode                 TCP Client
    C) Com 1 TX IP Address        0.0.0.0
    D) Com 1 TX IP Port           30010
    E) Com 1 TCP Keepalive        5 secs
    F) Com 1 Baud Rate            19200
    G) Com 1 Byte Format          8N1
    H) Com 1 Buffer Size          64 Bytes
    I) Com 1 Inter-Packet Delay 4 Character Times

    X) Commit Changes and Exit Wizard






Select a letter to choose item, <ESC> for the prev menu, 'Q' to quit wizard  _
```

Figure 3-46. TCP Client Menu (Remote)

- **Status**—Enable/Disable the serial data port.
- **Mode**—TCP Client. This is the type of IP port offered by the transceiver's serial device server. [**TCP, UDP; TCP**]
- **TX IP Address**—The IP address to be used as a destination for data received through the serial port. [**Any legal IP address; 0.0.0.0**]
- **TX IP Port**—The destination IP port for data packets received through the serial port on the transceiver. [**Any valid IP port; 30010**]
- **TCP Keepalive**—Amount of time (in seconds) that the transceiver waits for data before terminating the TCP session. [**0—600; 600**]
- **Baud Rate**—Data rate (payload) for the COM port, in bits-per-second. [**1,200—115,200; 19200**]
- **Byte Format**—Interface signaling parameters. Data bits, parity and stop bits. [**7N1, 7E1, 7O1, 8N1, 8E1, 8O1, 8N1, 7N2, 7E2, 7O2, 8N2, 8E2, 8O2; 8N1**]
- **Buffer Size**—Maximum amount of characters that the Remote end buffers locally before transmitting data through the serial port. [**1—255; 255**]

- **Inter-Frame Packet Delay**—A measurement representing the end of a message, measured in tenths of a second. [**default = 1 (that is, 1/10th of a second)**]
- **Commit Changes and Exit Wizard**—Save and execute changes made on this screen (shown only after changes have been entered).



```
                              AP_1655469
                     Serial Configuration Wizard Menu
 -==========================================================================-

     A) Com 1 Status                 disabled
     B) Com 1 Mode                   TCP Server
     C) Com 1 RX IP Port             30010
     D) Com 1 TCP Keepalive          5 secs
     E) Com 1 Baud Rate              19200
     F) Com 1 Byte Format            8N1
     G) Com 1 Buffer Size            255 bytes
     H) Com 1 Inter-Packet Delay     1 x 0.1 seconds

     X) Commit Changes and Exit Wizard








 Select a letter to choose item, <ESC> for the prev menu, 'Q' to quit wizard
```

Figure 3-47. TCP Server Menu (AP)

- **Status**—Enable/Disable the serial data port.
- **Mode**—TCP Server. This is the type of IP port offered by the transceiver's serial device server. [**TCP, UDP; TCP**]
- **RX IP Port**—Receive IP data from this source and pass it through to the connected serial device. The application connecting to the local TCP or UDP socket must use this port number. [**Any valid IP port; 30010**]
- **Baud Rate**—Data rate (payload) for the COM port, in bits-per-second. [**1,200—115,200; 19200**]
- **Byte Format**—Interface signaling parameters. Data bits, parity and stop bits. [**7N1, 7E1, 7O1, 8N1, 8E1, 8O1, 8N1, 7N2, 7E2, 7O2, 8N2, 8E2, 8O2; 8N1**]
- **Buffer Size**—Maximum amount of characters that the Remote end buffers locally before transmitting data through the serial port. [**1—255; 255**]
- **Inter-Packet Delay**—Amount of time that signal the end of a message, measured in tenths of a second. [**default = 1 (that is, 1/10th of a second)**]
- **Commit Changes and Exit Wizard**—Save and execute changes made on this screen (shown only after changes have been entered).

IP-to-Serial Application Example

You must choose UDP or TCP to establish communications. This depends on the type of device you are communicating with at the other end of the IP network. In this example, we will use TCP to illustrate its use.

In TCP mode, the transceiver remains in a passive mode, offering a socket for connection. Once a request is received, data received at the serial port is sent through the IP socket and vice versa, until the connection is closed or the link is interrupted. In this mode, the transceiver behaves the same, whether it is an Access Point or a Remote. (See Figure 3-48 and Table 3-4)

NOTE: The TCP session has a timeout of 10 minutes (600 seconds). If inactive for that time, the session is closed. The transceiver offers the port again for connection after this time expires.

Establishing a Connection

From the PC, establish a TCP connection to the IP address of the Remote transceiver and to the IP port as configured above (30010). Use a Telnet client application to establish this connection. Data can now be sent between the PC and the RTU or other connected device.

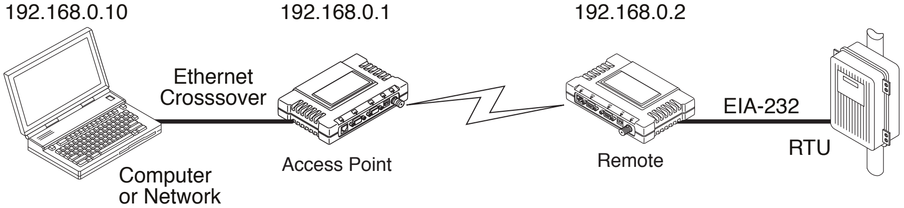


Figure 3-48. IP-to-Serial Application Diagram

Table 3-4. Serial Port Application Configuration

IP-to-Serial Connection

Transceiver Location	Menu Item	Setting
Access Point	None is required	None is required
Remote Unit	IP Address	192.168.0.2
	Status	Enabled
	IP Protocol	TCP
	Baud Rate	9,600 (Example)
	Flow Control	None
	Local IP Port	30010

Point-to-Point Serial-to-Serial Application Example

Once you have configured the transceivers, they begin processing data presented at the COM ports. Data presented at the Access Point's COM port is packetized and sent via UDP to the Remote. Upon receiving the packet, the Remote strips the data out of the UDP packet and sends it out its COM port. Likewise, data presented at the Remote's COM port is packetized, sent to the Access Point, stripped, and sent out the Access Point's COM port. This configuration does not use multicast addressing.

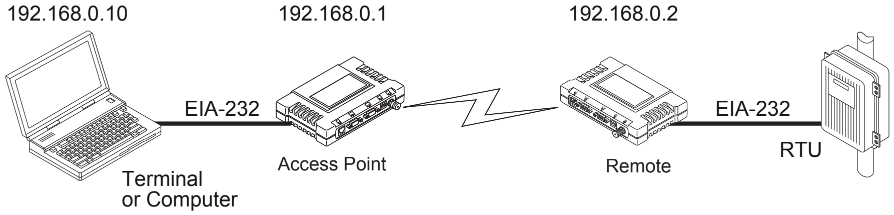


Figure 3-49. Point-to-Point Serial-to-Serial Application Diagram

Table 3-5. Serial Port Application Configuration

Transceiver Location	Menu Item	Setting
Access Point (COM1)	Status	Enabled
	Data Baud Rate	9,600 (Example)
	SIFD	4
	IP Protocol	UDP
	Remote IP Address	192.168.0.2 (IP address of the Remote radio)
	Remote IP Port	30010
	Local IP Port	30010
Remote Unit (COM1)	Status	Enabled
	Data Baud Rate	9,600 (Example)
	Flow Control	X-ON/X-OFF (Example)
	SIFD	4 (Characters)
	IP Protocol	UDP
	Remote IP Address	192.168.0.1 (IP address of the AP)
	Remote IP Port	30010
	Local IP Port	30010

Point-to-Multipoint Serial-to-Serial Application Example

The operation and data flow for this mode is very similar to Point-to-Point serial-to-serial application, except that it uses multicast addressing. The primary difference is that data presented at the Access Point's COM port is packetized and sent using UDP to all of the Remotes. Upon receiving the packet, all of the Remotes strip the data from the UDP packet and send it out their COM ports. Likewise, data presented at any of the Remotes' COM ports is packetized, sent to the Access Point, stripped, and sent out the Access Point's COM port (see Figure 3-50, Table 3-6, Figure 3-51, and Figure 3-52 on Page 88).

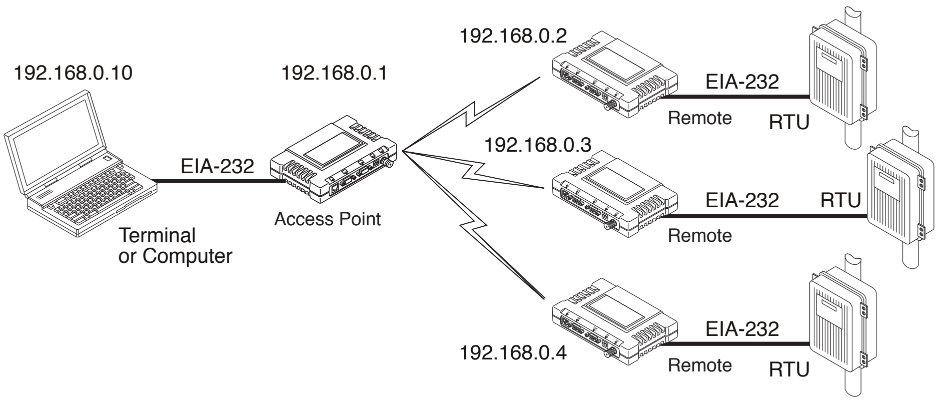
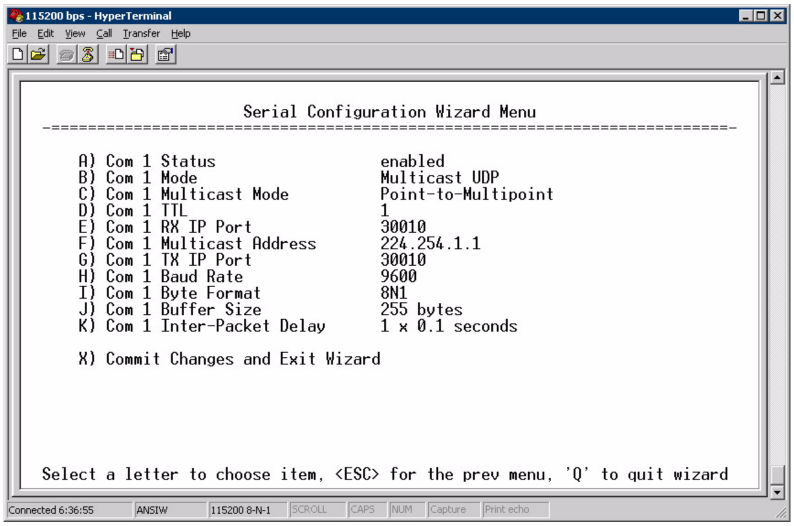


Figure 3-50. Point-to-Multipoint Serial-to-Serial Application Diagram

Table 3-6. Serial Port Application Configuration

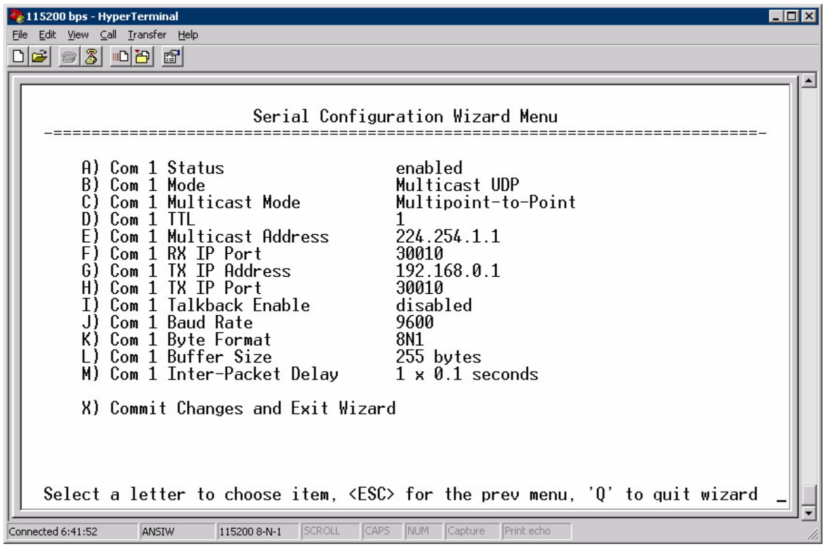
Transceiver Location	Menu Item	Setting
Access Point (COM1)	Status	Enabled
	Baud Rate	9600 (Example)
	Flow Control	Disabled
	IP Protocol	UDP
	Remote IP Address	224.254.1.1— Multicast Address[1]
	Remote IP Port	30010
	Local IP Port	30010
Remote Units (COM1)	Enable	Enabled
	Baud Rate	2,400 (Example)
	Flow Control	Hardware (Example)
	IP Protocol	UDP
	Remote IP Address	192.168.0.1
	Remote IP Port	30010
	Local IP Port	30010
	Local Multicast Address	224.254.1.1 — Multicast Address[2]

1. This address is an example only. Any Class D IP address (224.0.0.0—239.255.255.255) will work.



```
                      Serial Configuration Wizard Menu
-===========================================================================-

     A) Com 1 Status                  enabled
     B) Com 1 Mode                    Multicast UDP
     C) Com 1 Multicast Mode          Point-to-Multipoint
     D) Com 1 TTL                     1
     E) Com 1 RX IP Port              30010
     F) Com 1 Multicast Address       224.254.1.1
     G) Com 1 TX IP Port              30010
     H) Com 1 Baud Rate               9600
     I) Com 1 Byte Format             8N1
     J) Com 1 Buffer Size             255 bytes
     K) Com 1 Inter-Packet Delay      1 x 0.1 seconds

     X) Commit Changes and Exit Wizard



 Select a letter to choose item, <ESC> for the prev menu, 'Q' to quit wizard
```

Figure 3-51. Serial Port Configuration (Access Point)



```
                      Serial Configuration Wizard Menu
-===========================================================================-

     A) Com 1 Status                  enabled
     B) Com 1 Mode                    Multicast UDP
     C) Com 1 Multicast Mode          Multipoint-to-Point
     D) Com 1 TTL                     1
     E) Com 1 Multicast Address       224.254.1.1
     F) Com 1 RX IP Port              30010
     G) Com 1 TX IP Address           192.168.0.1
     H) Com 1 TX IP Port              30010
     I) Com 1 Talkback Enable         disabled
     J) Com 1 Baud Rate               9600
     K) Com 1 Byte Format             8N1
     L) Com 1 Buffer Size             255 bytes
     M) Com 1 Inter-Packet Delay      1 x 0.1 seconds

     X) Commit Changes and Exit Wizard



 Select a letter to choose item, <ESC> for the prev menu, 'Q' to quit wizard _
```

Figure 3-52. Radio Serial Port Configuration (Remote)

Mixed Modes

In this example, the TCP mode does not involve the Access Point. Thus, the transceiver in a single network can run in *both* modes at the same time. In other words, you can configure some Remotes for TCP mode and others (along with the Access Point) for UDP mode.

In this configuration, the Host PC can use both data paths to reach the RTUs. This is helpful when a mixed collection of RTUs is present where some RTUs can operate in a broadcast form while others cannot (see Figure 3-53 on Page 89 and Table 3-7 on Page 89).

Operation and Data Flow

- Communicate with RTU A by Telneting to Remote 1, port 30010.
- Communicate with RTU B by Telneting to Remote 2, port 30010.
- Communicate with RTUs C and D by sending and receiving data from the Access Point's COM port.
- All communication paths can be used simultaneously.

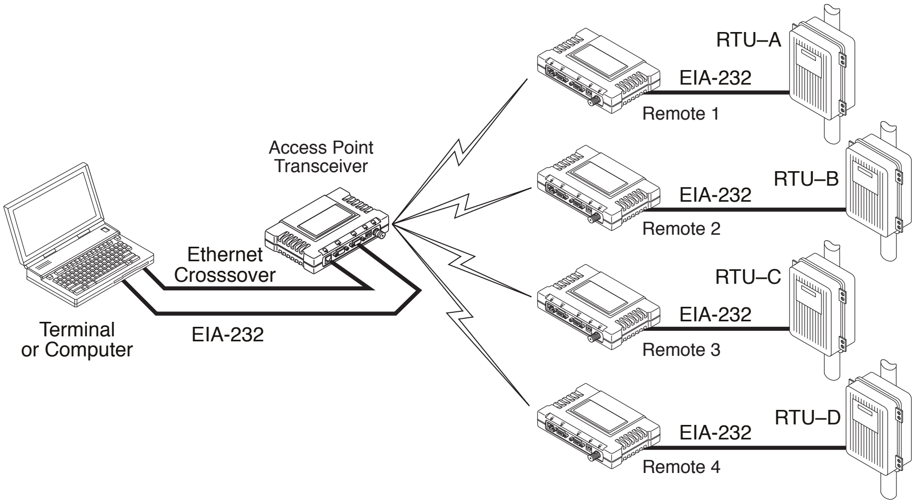


Figure 3-53. Mixed-Modes Application Diagram

Table 3-7. Serial Port Application Configuration

Transceiver Location	Menu Item	Setting
Access Point	Status	Enabled
	Baud Rate	9,600
	Flow Control	Disabled
	IP Protocol	UDP
	Send to Address	A multicast IP address such as 224.254.1.1
	Send to Port	30010
	Receive on Port	30010
	Receive on Address	0.0.0.0 (Not Used)
Remote Units 1 & 2 (COM1)	Status	Enabled
	Baud Rate	2,400
	Flow Control	Disabled
	IP Protocol	TCP
	Receive on Port	30010
Remote Units 3 & 4 (COM1)	Status	Enabled
	Baud Rate	9,600
	Flow Control	Disabled
	IP Protocol	UDP

Table 3-7. Serial Port Application Configuration *(Continued)*

Transceiver Location	Menu Item	Setting
	Send to Address	IP address of the AP
	Send to Port	30010
	Receive on Port	30010
	Receive on Address	224.254.1.1 (The multicast IP address used for the AP's Send To Address above)

3.6 MODBUS / TCP SERVER CONFIGURATION

Modbus is a serial communications protocol developed by Schneider Electric (Modicon) for communication between programmable logic controllers (PLCs), remote terminal units (RTUs) and other industrial electronic devices. It has become an established standard in the industry, and is now used by many manufacturers of industrial data equipment.

Mercury Series transceivers running version 2.2.0 firmware or later include Modbus functionality. This section of the addendum contains an overview of the Modbus/TCP Server and provides menu details for using this feature. You should also review *Configuring for TCP Mode section on Page 83*.

NOTE: This material assumes you have an understanding of Ethernet networking, TCP/IP, and Modbus serial protocols. Refer to the following web site for additional information: **www.modicon.com/TECHPUBS/intr7.html**.

NOTE: Modbus/TCP functionality is provided on the COM1 port of the transceiver only.

3.6.1 Modbus/TCP in Mercury Transceivers—An Overview

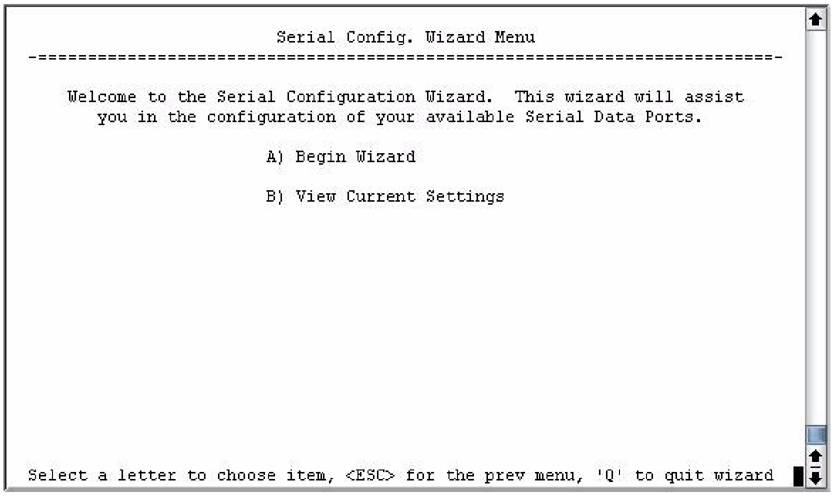
The transceiver implements a Modbus/TCP server that bridges Modbus/TCP to either: **Modbus RTU** or **Modbus/ASCII**. It does *not* function as a Modbus/TCP client.

The transceiver converts Modbus/TCP requests to either RTU or ASCII serial Modbus packets and sends them to the configured serial port. It waits up to the timeout period for a reply on the serial port, and if one arrives, it converts the response back to Modbus/TCP and sends it to the connected Modbus/TCP client.

3.6.2 Menu Selections

Connect a PC to the transceiver as described in *STEP 3: CONNECT PC TO THE TRANSCEIVER* section on Page 25, and access the embedded management system. Follow the steps below to proceed with Modbus/TCP configuration.

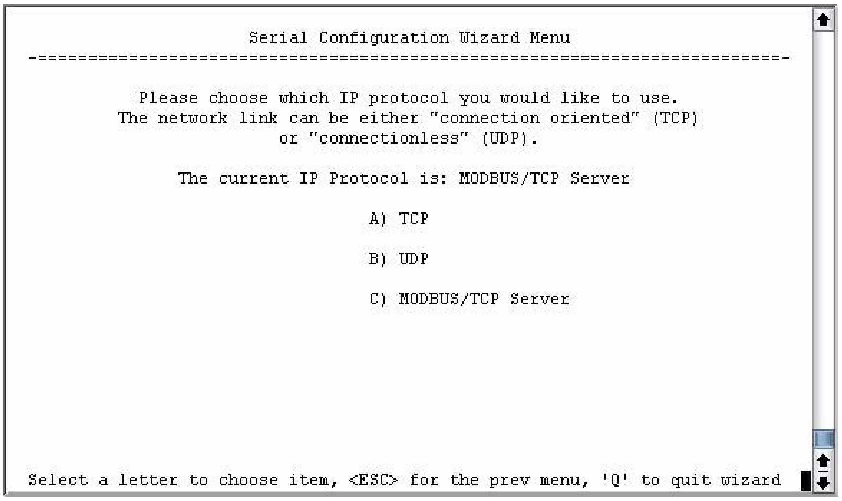
1. From the Serial Configuration Wizard opening screen (Figure 3-54 on Page 91), select **A** to begin the wizard.



```
                    Serial Config. Wizard Menu
-==========================================================================-

    Welcome to the Serial Configuration Wizard.  This wizard will assist
       you in the configuration of your available Serial Data Ports.

                        A) Begin Wizard

                        B) View Current Settings




Select a letter to choose item, <ESC> for the prev menu, 'Q' to quit wizard
```

Figure 3-54. Configuration Wizard Opening Screen

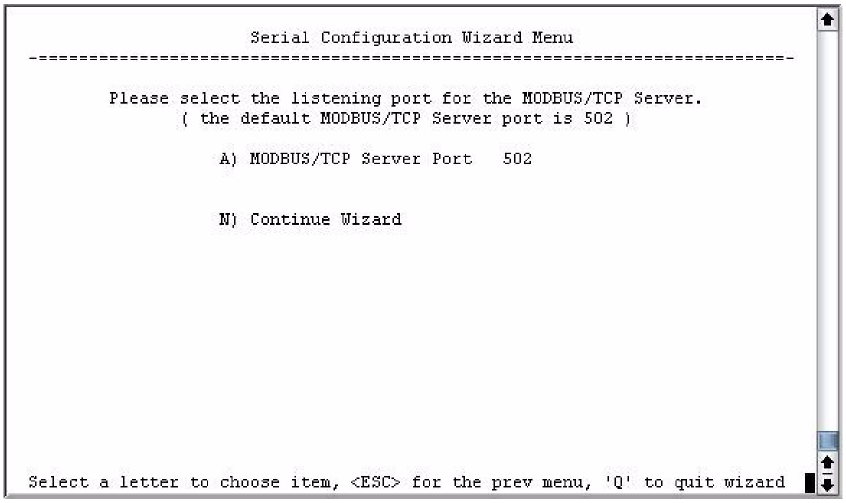
2. Choose the IP protocol you wish to use (TCP, UDP, or Modbus/TCP) by selecting the appropriate letter from the menu.



```
                 Serial Configuration Wizard Menu
-==========================================================================-

          Please choose which IP protocol you would like to use.
        The network link can be either "connection oriented" (TCP)
                      or "connectionless" (UDP).

              The current IP Protocol is: MODBUS/TCP Server

                            A) TCP

                            B) UDP

                            C) MODBUS/TCP Server




Select a letter to choose item, <ESC> for the prev menu, 'Q' to quit wizard
```

Figure 3-55. IP Protocol Selection Screen

3. On the next screen (Figure 3-56 on Page 92), choose the listening port you wish to use for the Modbus/TCP server. The default is port **502**. Press **N** to continue.

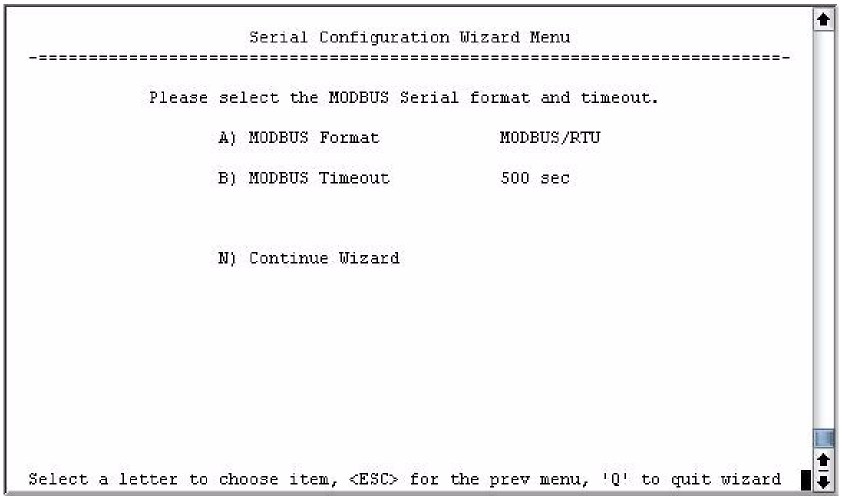


```
                    Serial Configuration Wizard Menu
-========================================================================-

        Please select the listening port for the MODBUS/TCP Server.
               ( the default MODBUS/TCP Server port is 502 )

                    A) MODBUS/TCP Server Port   502


                    N) Continue Wizard








Select a letter to choose item, <ESC> for the prev menu, 'Q' to quit wizard
```

Figure 3-56. Modbus/TCP Server Listening Port

4. On the next screen (Figure 3-57), press **A** to change the Modbus serial format, then press the space bar to toggle between the available formats (**MODBUS/RTU** or **MODBUS/ASCII**). Press **B** to enter the Modbus serial timeout value in milliseconds. Press **N** to continue the wizard.

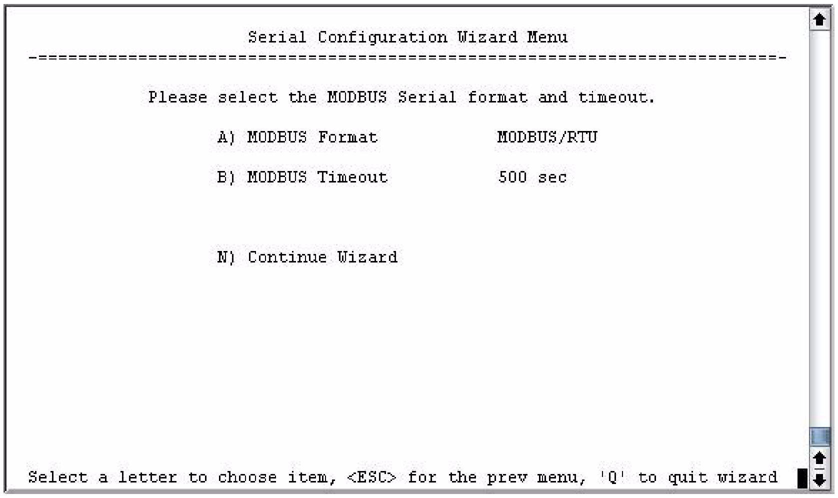
NOTE: The only difference between Modbus/RTU and Modbus/ASCII is the form of the framing sequence, error check pattern, and address interpretation.



```
                    Serial Configuration Wizard Menu
-========================================================================-

            Please select the MODBUS Serial format and timeout.

                    A) MODBUS Format           MODBUS/RTU

                    B) MODBUS Timeout          500 sec


                    N) Continue Wizard








Select a letter to choose item, <ESC> for the prev menu, 'Q' to quit wizard
```

Figure 3-57. Choose Modbus Serial Format and Timeout Value
Note: Modbus Timeout setting is in milliseconds, not seconds as displayed in the example above.

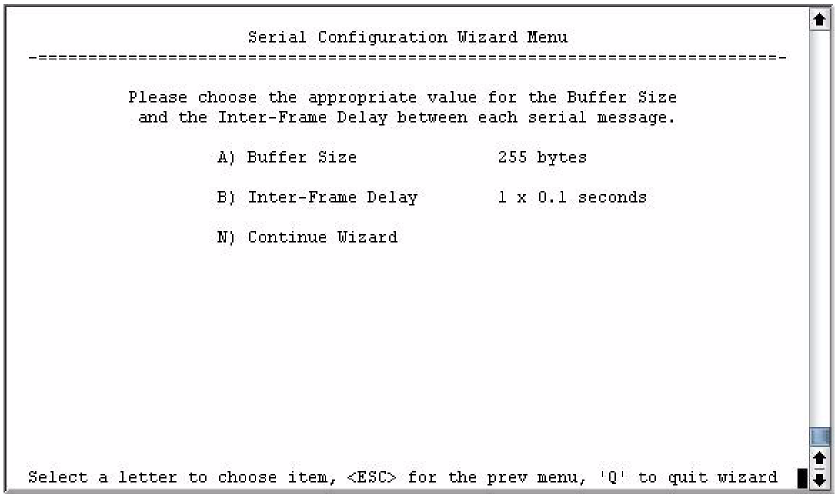
5. When the next screen appears (Figure 3-58), press **A** to select the desired data baud rate and **B** to select the data byte format. Press **N** to continue.



```
                    Serial Configuration Wizard Menu
-==========================================================================-

            Please select the MODBUS Serial format and timeout.

                   A) MODBUS Format            MODBUS/RTU

                   B) MODBUS Timeout           500 sec


                   N) Continue Wizard









 Select a letter to choose item, <ESC> for the prev menu, 'Q' to quit wizard
```

Figure 3-58. Select Data Baud Rate and Byte Format

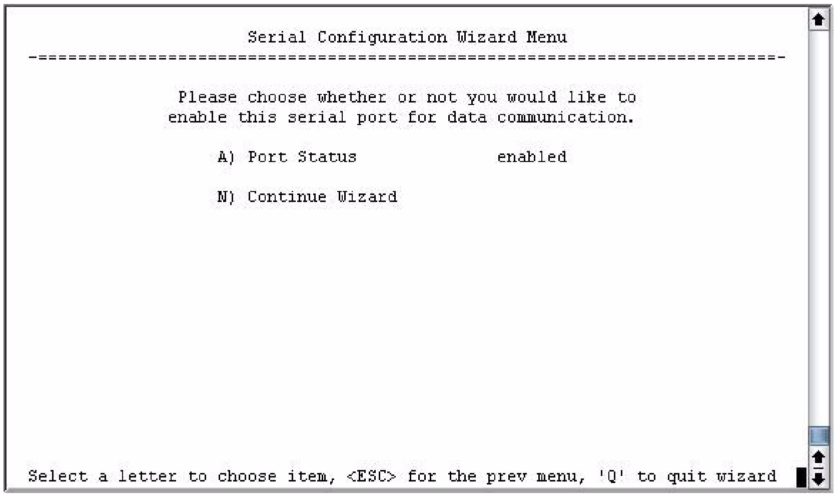
6. The screen shown in Figure 3-59 appears next. Press **A** to select the Buffer Size of message packets, and **B** to select the Inter-Frame Delay. Press **N** to continue with the wizard.



```
                    Serial Configuration Wizard Menu
-==========================================================================-

          Please choose the appropriate value for the Buffer Size
           and the Inter-Frame Delay between each serial message.

                   A) Buffer Size              255 bytes

                   B) Inter-Frame Delay        1 x 0.1 seconds

                   N) Continue Wizard










 Select a letter to choose item, <ESC> for the prev menu, 'Q' to quit wizard
```

Figure 3-59. Buffer Size and Inter-Frame Delay Values

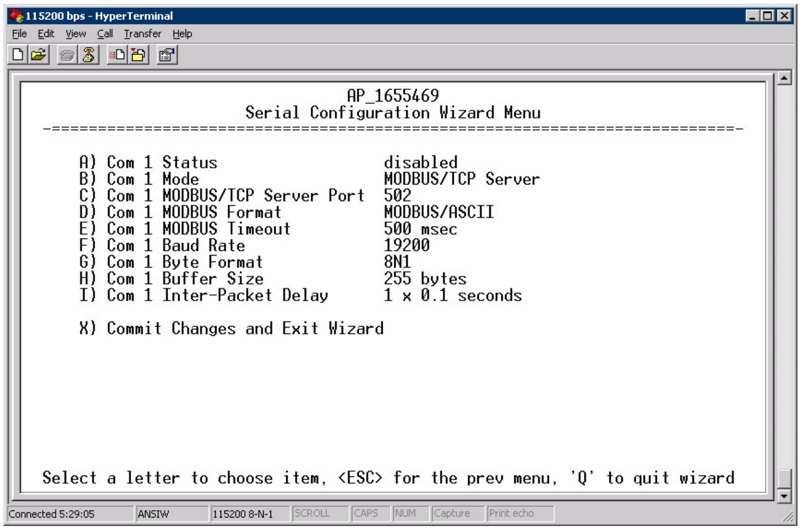
7. On the next screen (Figure 3-60 on Page 94), select **A** and use the spacebar to enable the serial port for data communication. Press **N** to continue the wizard.



```
                    Serial Configuration Wizard Menu
-==========================================================================-

                Please choose whether or not you would like to
               enable this serial port for data communication.

                   A) Port Status             enabled

                   N) Continue Wizard




Select a letter to choose item, <ESC> for the prev menu, 'Q' to quit wizard
```

Figure 3-60. Serial Port Status Screen

8. Review all settings on the summary screen shown in Figure 3-61. If all settings are correct, press **X** to confirm and exit the wizard. If not, select the letter of the item(s) you wish to change.



```
                                AP_1655469
                      Serial Configuration Wizard Menu
-==========================================================================-

      A) Com 1 Status                 disabled
      B) Com 1 Mode                   MODBUS/TCP Server
      C) Com 1 MODBUS/TCP Server Port  502
      D) Com 1 MODBUS Format          MODBUS/ASCII
      E) Com 1 MODBUS Timeout         500 msec
      F) Com 1 Baud Rate              19200
      G) Com 1 Byte Format            8N1
      H) Com 1 Buffer Size            255 bytes
      I) Com 1 Inter-Packet Delay     1 x 0.1 seconds

      X) Commit Changes and Exit Wizard




Select a letter to choose item, <ESC> for the prev menu, 'Q' to quit wizard
```

Figure 3-61. Serial Configuration□Summary Screen

This completes the menu selections for Modbus/TCP operation.

3.7 SECURITY CONFIGURATION MENU

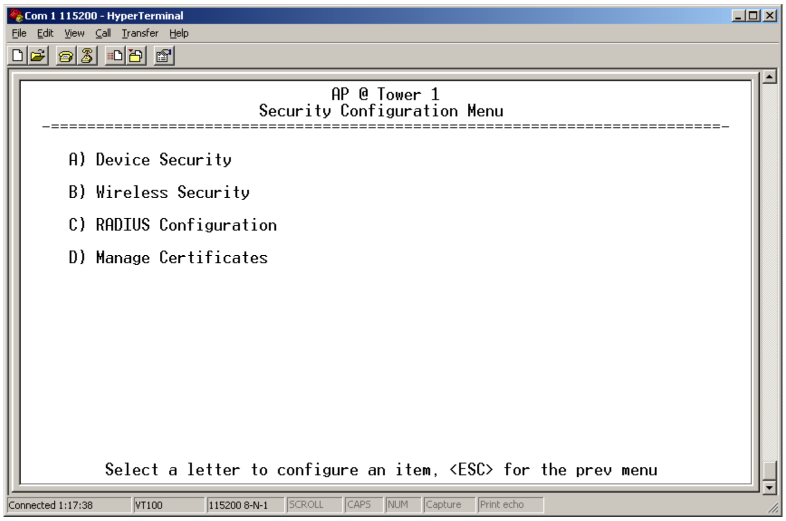
The transceiver’s security features are grouped into four major categories and are accessible from the Security Configuration Menu (see Figure 3-62). These categories are:

Device Security—Contains settings for controlling access to the radio itself for configuration and management.

Wireless Security—Controls how and when radios communicate with each other, as well as how data traffic is handled.

RADIUS Configuration—Deals with IEEE 802.1x device authentication and authorization using a central server.

Manage Certificates (Remote only)—Allows setting of certificate types, download paths, and TFTP parameters.



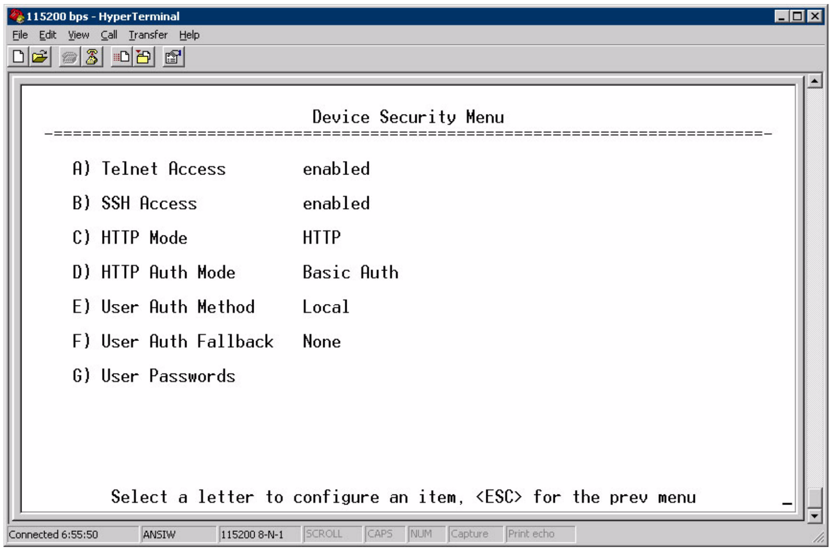
```
                              AP @ Tower 1
                      Security Configuration Menu
 -==========================================================================-

     A) Device Security

     B) Wireless Security

     C) RADIUS Configuration

     D) Manage Certificates






         Select a letter to configure an item, <ESC> for the prev menu
```

Figure 3-62. Security Configuration Menu

Selecting any of the Security Configuration Menu items opens a sub-menu where you can view or change settings. Examples of these screens and more detailed descriptions of their contents are provided below.

3.7.1 Device Security Menu

The Device Security Menu (Figure 3-63) controls how the radios can be accessed either locally or remotely for configuration and management.

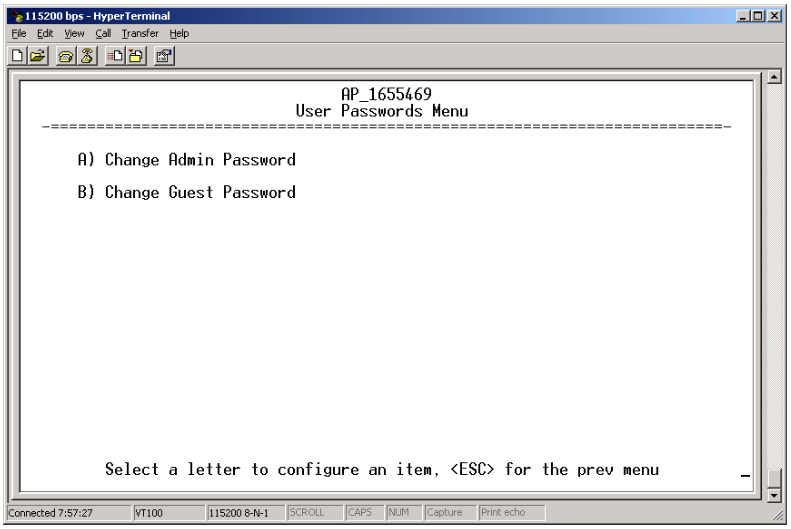


```
                        Device Security Menu
 -===========================================================================-

    A) Telnet Access        enabled

    B) SSH Access           enabled

    C) HTTP Mode            HTTP

    D) HTTP Auth Mode       Basic Auth

    E) User Auth Method     Local

    F) User Auth Fallback   None

    G) User Passwords




        Select a letter to configure an item, <ESC> for the prev menu
```

Figure 3-63. Device Security Menu

- **Telnet Access**—Controls Telnet access to the transceiver's management system. [**enabled, disabled; enabled**]
- **SSH Access**—Controls access to the Secure Shell (SSH) server. [**enabled, disabled; enabled**]
- **HTTP Mode**—Controls access to the transceiver's management system via the web server. [**disabled, HTTP, HTTPS; HTTP**]
- **HTTP Auth Mode**—Selects the mode used for authenticating a web user. [**Basic Auth, MD5 Digest; Basic Auth**]
- **User Auth Method**—View/set the method of authentication for users. [**Local, Radius; Local**]
- **User Auth Fallback**—View/set method of authentication to use if the RADIUS server is unavailable. [**None, Local; None**]
- **User Passwords**—Allows changing of Administrative and Guest passwords. When selected, a new screen appears (Figure 3-64 on Page 97).

User Passwords Menu



```
                         AP_1655469
                     User Passwords Menu
-==========================================================================-

    A) Change Admin Password

    B) Change Guest Password









      Select a letter to configure an item, <ESC> for the prev menu
```

Figure 3-64. User Passwords Menu

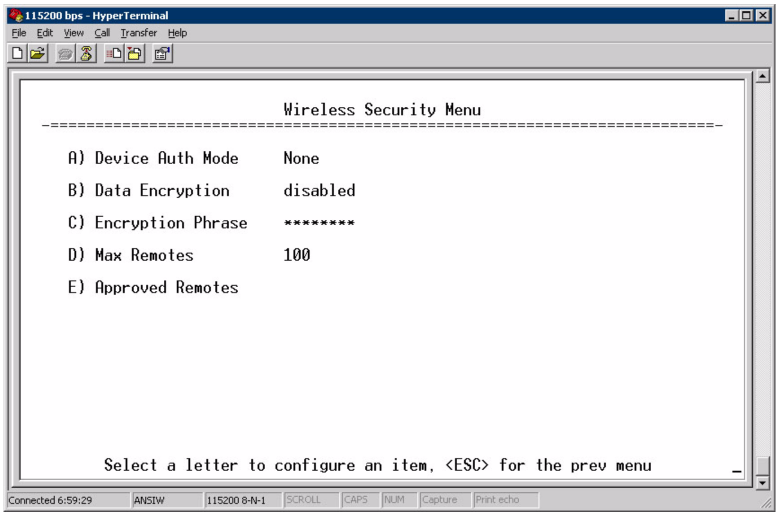
To change the Administrator or Guest password, select the appropriate menu item (A or B). A flashing cursor appears to the right. From here, type the new password, which can be any alpha-numeric string up to 13 characters long. The change is asserted when you press the Return key.

- **Change Admin Password**—Allows you to set a new password. [**any alpha-numeric string up to 13 characters; admin**]
- **Change Guest Password**—Allows you to set a new password. [**any alpha-numeric string up to 13 characters; guest**]

TIP: For enhanced security, consider using misspelled words, a combination of letters and numbers, and a combination of upper and lower case letters. Also, the more characters used (up to 13), the more secure the password. These strategies help protect against sophisticated hackers who use a database of common words (for example, dictionary attacks) to determine a password.

3.7.2 Wireless Security Menu

The features in the Wireless Security menu (Figure 3-65 on Page 98) control the communication of data across the wireless link. You can authenticate the radios locally via a list of authorized radios, or remotely via a centralized IEEE 802.1x device authentication server. This server provides a centralized authentication mechanism based on standards.



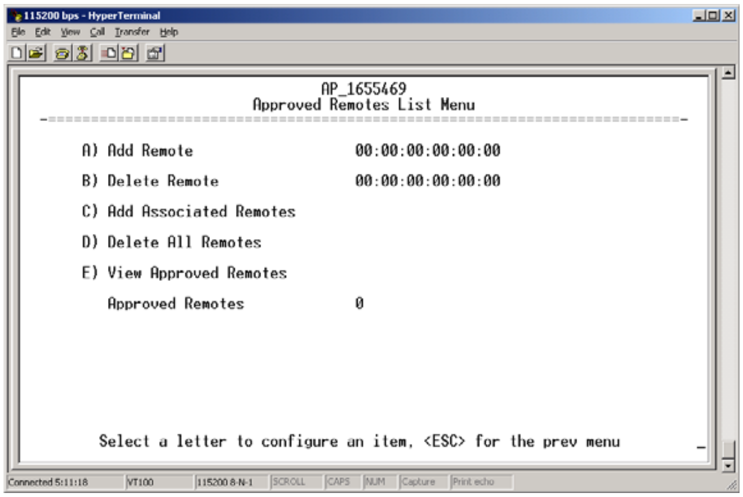
```
                              Wireless Security Menu
-==========================================================================-

     A) Device Auth Mode      None
     B) Data Encryption       disabled
     C) Encryption Phrase     ********
     D) Max Remotes           100
     E) Approved Remotes

         Select a letter to configure an item, <ESC> for the prev menu
```

Figure 3-65. Wireless Security Menu

- **Device Auth Mode**—View/set the device's authentication method. [**None, Local, IEEE 802.1X; None**]
- **Data Encryption**—Controls the over-the-air payload data's AES-128 bit encryption. [**enable, disable; disabled**]
- **Encryption Phrase**—View/set the phrase used to generate encryption keys when encrypting over-the-air payload. [**any alpha-numeric string of 8 to 15 characters; <empty>**]
- **Max Remotes** (AP only)—The maximum number of remotes an AP can associate with.
- **Approved Remotes** (AP only)—Launches a submenu where you can view, add, or delete approved Remotes. (See Figure 3-66.)

Approved Remotes Submenu

Setting the **Device Auth Mode** to **Local** forces an AP to check the *Approved Remotes List* before establishing a radio link. A Remote must be in the list before the AP associates and grants authorization. Before enabling this option, at least one entry must already exist in the **View Approved Remotes** list.



```
                              AP_1655469
                       Approved Remotes List Menu
 -=====================================================================-

       A) Add Remote                 00:00:00:00:00:00

       B) Delete Remote              00:00:00:00:00:00

       C) Add Associated Remotes

       D) Delete All Remotes

       E) View Approved Remotes

          Approved Remotes           0




         Select a letter to configure an item, <ESC> for the prev menu
```

Figure 3-66. Approved Remotes Submenu

- **Add Remote**—Enter the MAC address of Remote. [**Any valid 6-digit hexadecimal MAC address; 00:00:00:00:00:00**]
- **Delete Remote**—Enter the MAC address of Remote. For security purposes, you should delete a stolen or deprovisioned radio from this list.
- **Add Associated Remotes**—Add all currently associated remotes to the approved remote list. Alternatively, you can enter each Remote MAC manually.
- **Delete All Remotes**—Remove (complete purge) all Remotes from current list.
- **View Approved Remotes**—Listing of approved Remotes by MAC address. These radios are authorized to join this AP. If a Remote is not in this list, it cannot associate with this AP.

3.7.3 IEEE 802.1x Device Authentication

This section covers the configuration needed for the radios to access the IEEE 802.1x device authentication server, which provides Device Level Security and for Wireless Access Security. GE MDS does not provide the server software.

Operation of Device Authentication

Device authentication forces the radio to authenticate before allowing user traffic to traverse the wireless network. When Device Security is configured to use IEEE 802.1x as the Authentication Method, Remote radios need three types of certificates: public (client), private, and root (Certificate Authority). These files are unique to each Remote radio and must first be created at the server and then installed into each unit via TFTP. The certificate files must be in DER format.

Device authentication uses the serial number of each radio as the Common Name (CN) in its certificate and in its RADIUS identity field.

Each Access Point *and* Remote radio must be identified/recognized by the device authentication server through the Common Name (Serial number) and IP address entries.

NOTE: Consult your network administrator for assistance in configuration, or for help with other issues that may arise.

To activate device authentication, select **Device Auth Method** and set **RADIUS** as the active mode. The behavior of this setting differs depending on whether it is implemented on an Access Point or a Remote transceiver. An explanation of these behaviors is given below:

Access Point: When **Device Auth Method** is set to **RADIUS**, the AP disassociates all associated Remotes and waits for the device authentication server to authenticate the Remotes before allowing data from them to pass. When approval is received from the authentication server, data from the Remote passes.

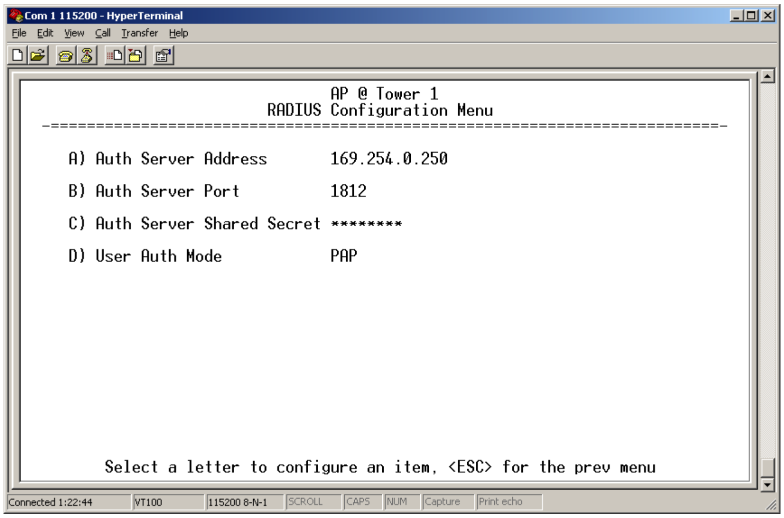
Remote: When **Device Auth Method** is set to **RADIUS**, the Remote halts any data it is passing, and requests Authentication from the device authentication server. If accepted, data is transmitted.

Operation of User Authentication

User Authentication controls authentication of *users* who can manage the device. This is in contrast to Device Authentication (above), which authenticates *devices* that can participate in the data network. When user authentication is set to **Local** or **RADIUS**, you must enter a valid user name and password before you can manage the radio. In **RADIUS** mode, both of these fields can be up to 40 characters long. In **Local** mode the user name is **admin** and the password can be up to 13 characters long.

When set to **RADIUS**, *all* logins to the local configuration services must be authenticated via the device authentication server, including Telnet and SSH (Secure Shell) sessions. Authentication must be accepted before access to the radio menu is granted.

RADIUS Configuration Menu



```
                              AP @ Tower 1
                        RADIUS Configuration Menu
-============================================================================-

    A) Auth Server Address       169.254.0.250

    B) Auth Server Port          1812

    C) Auth Server Shared Secret ********

    D) User Auth Mode            PAP







        Select a letter to configure an item, <ESC> for the prev menu
```

Figure 3-67. Radius Configuration Menu

- **Auth Server Address**—The IP address of the authentication server. [**any valid IP address; 0.0.0.0**]
- **Auth Server Port**—The UDP Port of the authentication server. [**1812, 1645, 1812**]
- **Auth Server Shared Secret**—User authentication and Device authentication require a common shared secret to complete an authentication transaction. This entry must match the string used to configure the appropriate files on the authentication server.
  [**<empty>; any alpha-numeric string up to 16 characters**]
- **User Auth Mode**—RADIUS Authentication algorithm. [**PAP, CHAP, EAP; PAP**]. Note that CHAP is a more secure algorithm than PAP. PAP may display the login password in log files at the authentication server while CHAP will encrypt this information.

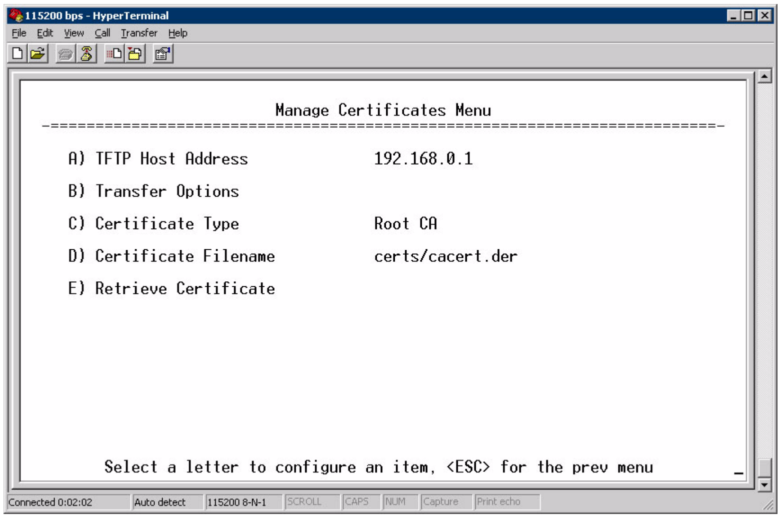
NOTE: In the Mercury Remote with WiFi, running in *Station* mode, and using WPA Enterprise or WPA2 Enterprise privacy, a station suffering a power loss and rebooting might have its date and time reset. This is because the RADIUS server uses the station's date to validate its certificates, and if the reset date and time is earlier than the date and time on the certificates, validation will fail and the station will be unable to join the WiFi network without user intervention. To prevent this, it is recommended that there be a way for the station to obtain an accurate date and time, whether through GPS service, or an SNTP server located on the radio network.

NOTE: *In a Remote with WiFi*, the same Radius configuration is used for IEEE 802.1x user and device authentication, as well as WiFi WPA Enterprise or WPA2 Enterprise authentication. The User Auth Mode setting does not matter for WiFi purposes.

3.7.4 Manage Certificates

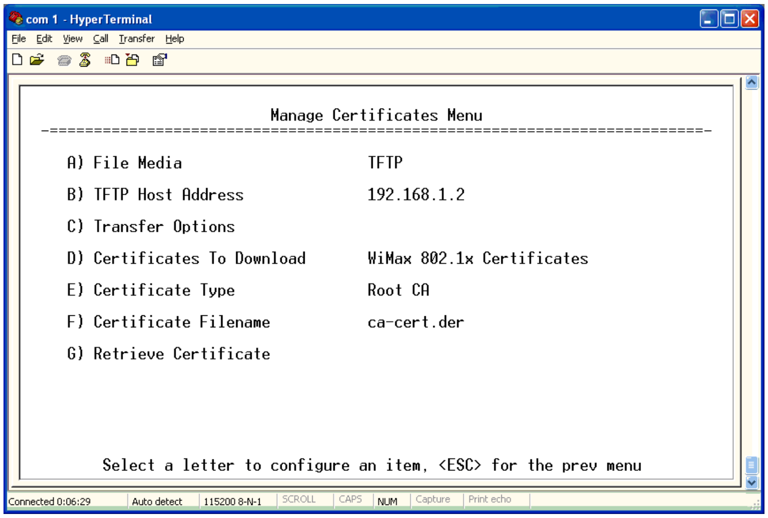
Use Certificate generation software to generate certificate files, then install these files into each Remote unit using TFTP. This is done using the Manage Certificates Menu (Figure 3-68 on Page 102).

The certificate files must be in DER format. The Common Name (CN) field in the public certificate file must match the serial number of the unit it is installed on.



```
                          Manage Certificates Menu
 -==========================================================================-

    A) TFTP Host Address             192.168.0.1

    B) Transfer Options

    C) Certificate Type              Root CA

    D) Certificate Filename          certs/cacert.der

    E) Retrieve Certificate




         Select a letter to configure an item, <ESC> for the prev menu
```

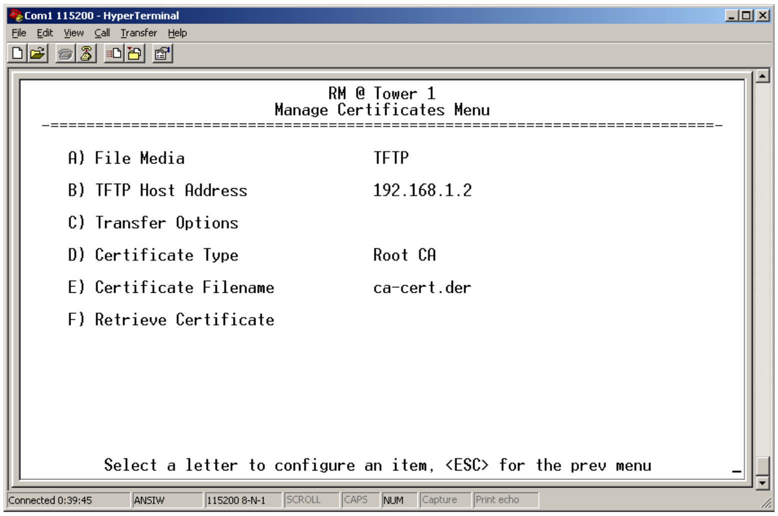
Figure 3-68. Manage Certificates Menu



com 1 - HyperTerminal
File Edit View Call Transfer Help
Connected 0:06:29 Auto detect 115200 8-N-1 SCROLL CAPS NUM Capture Print echo

```
                       Manage Certificates Menu
 -============================================================================-

   A) File Media                       TFTP

   B) TFTP Host Address                192.168.1.2

   C) Transfer Options

   D) Certificates To Download         WiMax 802.1x Certificates

   E) Certificate Type                 Root CA

   F) Certificate Filename             ca-cert.der

   G) Retrieve Certificate




       Select a letter to configure an item, <ESC> for the prev menu
```

Figure 3-69. Manage Certificates Menu, TFTP Mode
(Remote with WiFi only)



Com1 115200 - HyperTerminal
File Edit View Call Transfer Help
Connected 0:39:45 ANSIW 115200 8-N-1 SCROLL CAPS NUM Capture Print echo

```
                              RM @ Tower 1
                        Manage Certificates Menu
 -============================================================================-

   A) File Media                       TFTP

   B) TFTP Host Address                192.168.1.2

   C) Transfer Options

   D) Certificate Type                 Root CA

   E) Certificate Filename             ca-cert.der

   F) Retrieve Certificate




       Select a letter to configure an item, <ESC> for the prev menu
```

Figure 3-70. Manage Certificates Menu, USB Mode
(Remote with WiFi only)

- **File Media**—A selection of methods for transferring files to and from the radio. On firmware version 3.0 radios, the options are **TFTP** and **USB**.
- **TFTP Host Address**—*(Telnet/Terminal only)*—IP address of the computer on which the TFTP server resides. This same IP address is used in other screens/functions (reprogramming, logging, etc.). Changing it here also changes it for other screens/functions. [**Any valid IP address; 127.0.0.1**].
- **Transfer Options**—A menu for configuring the TFTP transfer. (See Figure 3-71 on Page 104.)

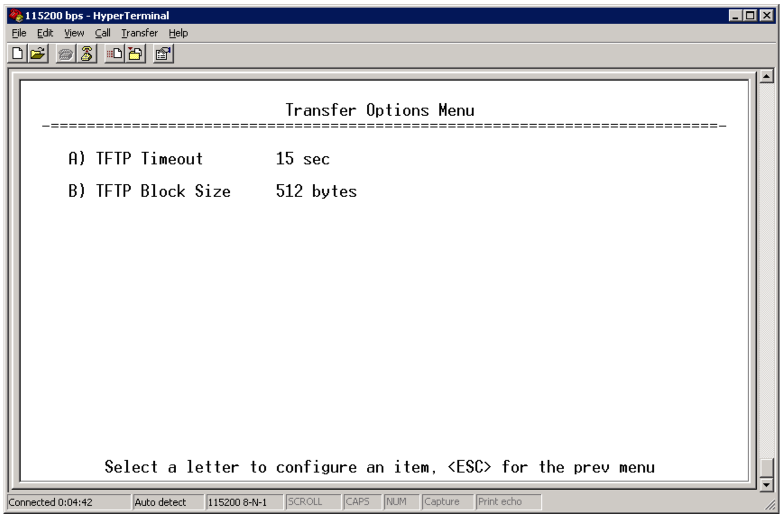
- **Certificates to Download**—WiMax certificates may be used for IEEE 802.1x user and device authentication, as well as WiFi WPA Enterprise and WPA2 Enterprise mode. WiFi certificates may only be used for WPA Enterprise and WPA2 Enterprise authentication.

  One set of each certificate type can be on the radio at one time. You specify which certificates to use for WPA Enterprise and WPA2 Enterprise on the 802.11 Security Menu. **[WiMax Certificates, WiFi Certificates; WiMax Certificates]**

Three certificate files (Root CA, Client, and Private Key) must be present in *each* of the Remote radios. Use the commands described below to install these files into each Remote radio:

- **Certificate Type**—Selects one of the three certificate file types mentioned above. [**Root CA, Client, Private Key; Root CA**]
- **Certificate Filename**—Specifies the software path and filename for downloading certificates.
- **Retrieve Certificate**—Initiates the retrieval of the certificate file from the storage location. A successful installation issues a **Complete** status message.

NOTE: It is *imperative* that the three certificate files are installed correctly into the Remote radio, in their respective file types. If they are not, the Remote is un-authenticated for data traffic. Consult your network administrator for more information.



```
                    Transfer Options Menu
-========================================================================-

   A) TFTP Timeout       15 sec

   B) TFTP Block Size    512 bytes





      Select a letter to configure an item, <ESC> for the prev menu
```

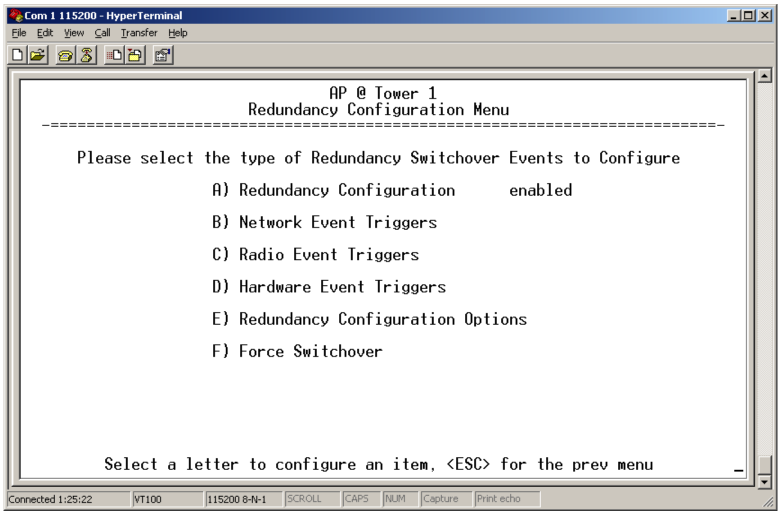
Figure 3-71. Transfer Options Menu

- **TFTP Timeout**—The time the client radio will wait for a response from the server before ending the transfer.
- **TFTP Block Size**—The amount of data sent in each TFTP packet.

3.8 REDUNDANCY CONFIGURATION (AP ONLY)

For operation in protected (redundant) mode, an AP must be in a Packaged P23 enclosure with a backup radio. See MDS publication 05-4161A01 for details. This manual is available under the **Downloads** tab at **www.GEmds.com**.

The Redundancy Configuration Menu (Figure 3-72) is where you enable/disable redundancy operation and define the triggers that will cause a switchover.

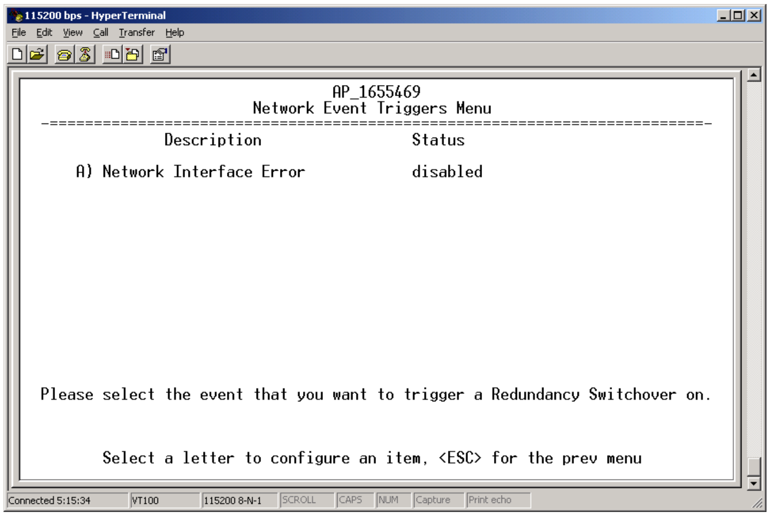


```
                          AP @ Tower 1
                  Redundancy Configuration Menu
-=========================================================================-

    Please select the type of Redundancy Switchover Events to Configure

                A) Redundancy Configuration      enabled

                B) Network Event Triggers

                C) Radio Event Triggers

                D) Hardware Event Triggers

                E) Redundancy Configuration Options

                F) Force Switchover




      Select a letter to configure an item, <ESC> for the prev menu
```

Figure 3-72. Redundancy Configuration Menu (AP Only)

- **Redundancy Configuration**—Enable/disable redundancy switchover for AP. [**enabled, disabled; disabled**]
- **Network Event Triggers**—This selection opens a submenu (Figure 3-73 on Page 106) where you can set/view the trigger status for Network Events.
- **Radio Event Triggers**—This selection opens a submenu (Figure 3-74 on Page 106) where you can set/view the trigger status for Radio Events, such as a loss of associated Remotes or excessive packet errors.
- **Hardware Event Triggers**—This selection opens a submenu (Figure 3-75 on Page 107) where you can set/view the trigger status for initialization/hardware errors.
- **Redundancy Configuration Options**—This selection opens a submenu (Figure 3-76 on Page 107) where you can set the threshold criteria for declaring an error event.
- **Force Switchover**—Selecting this option forces a manual (user initiated) switchover to the backup AP. The “challenge question” **Are you sure? (y/n)** is presented to avoid an unintended switchover. To invoke the change, press the letter **y** followed by the Enter key.

Network Event Triggers Menu

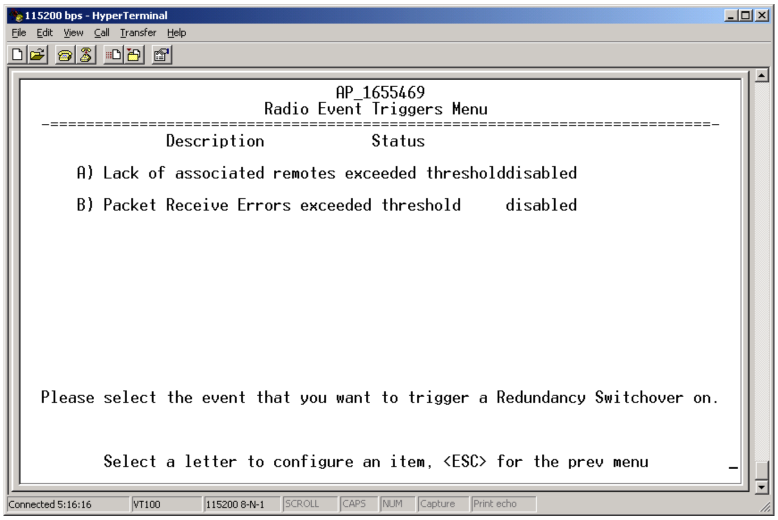


```
                              AP_1655469
                       Network Event Triggers Menu
-==========================================================================-
             Description                     Status

    A) Network Interface Error               disabled













 Please select the event that you want to trigger a Redundancy Switchover on.


        Select a letter to configure an item, <ESC> for the prev menu
```

Figure 3-73. Network Events Triggers Menu

- **Network Interface Error**—This setting determines whether or not a network interface error will cause redundancy switchover. [**enabled, disabled; disabled**]

Radio Event Triggers

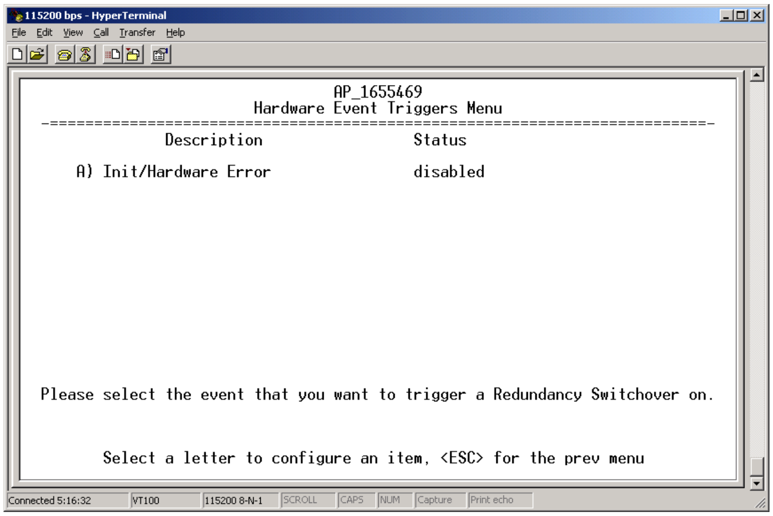


```
                              AP_1655469
                        Radio Event Triggers Menu
-==========================================================================-
             Description                Status

    A) Lack of associated remotes exceeded thresholddisabled

    B) Packet Receive Errors exceeded threshold     disabled












 Please select the event that you want to trigger a Redundancy Switchover on.


        Select a letter to configure an item, <ESC> for the prev menu    _
```

Figure 3-74. Radio Event Triggers

- **Lack of associated remotes exceeded threshold**—This setting determines whether or not a switchover occurs when a lack of associated Remote units exceeds the time period set in Figure 3-77 on Page 108. [**enabled, disabled; disabled**]
- **Packet Receive Errors exceeded threshold**—This setting determines whether or not a switchover occurs when the number of Packet Receive errors exceeds the number set in Figure 3-78 on Page 108. [**enabled, disabled; disabled**]

Hardware Event Triggers



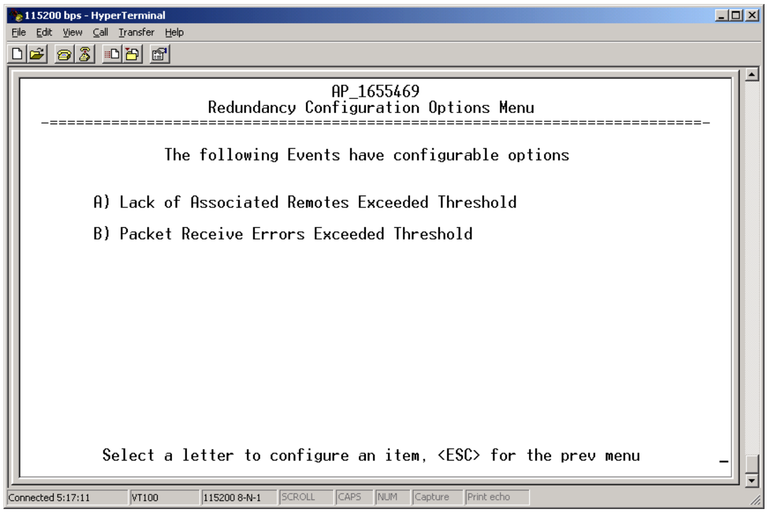
```
                              AP_1655469
                      Hardware Event Triggers Menu
 -==========================================================================-
               Description                        Status

     A) Init/Hardware Error                       disabled









 Please select the event that you want to trigger a Redundancy Switchover on.


        Select a letter to configure an item, <ESC> for the prev menu
```

Figure 3-75. Hardware Event Triggers

- **Init/Hardware Error**—This setting determines whether or not an initialization or hardware error results in a redundancy switchover. [**enabled, disabled; disabled**]

Redundancy Configuration Options Menu

Use this menu (Figure 3-76) to set the thresholds for the Lack of Associated Remotes and Packet Receive Errors. Selecting either item opens a submenu where you can view or change settings.



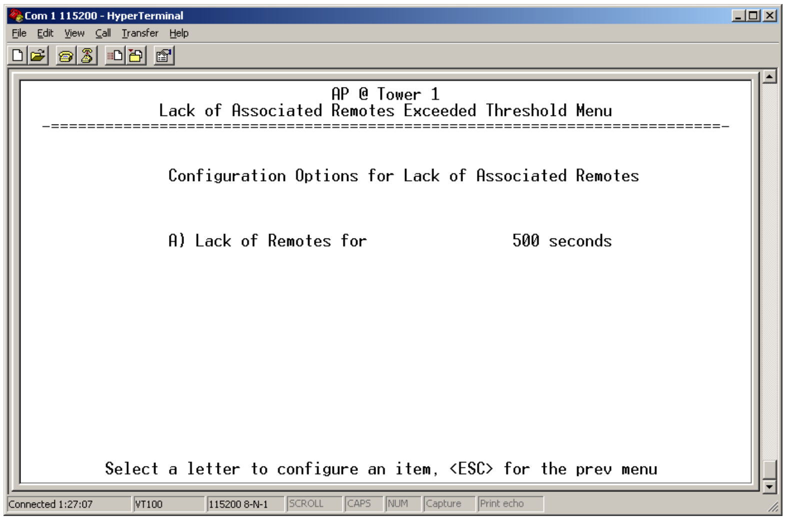
```
                              AP_1655469
                   Redundancy Configuration Options Menu
 -==========================================================================-

                The following Events have configurable options

         A) Lack of Associated Remotes Exceeded Threshold

         B) Packet Receive Errors Exceeded Threshold









        Select a letter to configure an item, <ESC> for the prev menu     _
```

Figure 3-76. Redundancy Configuration Options Menu

- **Lack of Associated Remotes Exceeded Threshold**—This selection opens a submenu (Figure 3-77) where you can view or change the time period allowed for a lack of associated Remotes.

- **Packet Receive Errors Exceeded Threshold**—This selection opens a submenu (Figure 3-78 on Page 108) where you can view or change the maximum allowable number of receive errors.

Lack of Associated Remotes Exceeded Threshold Menu

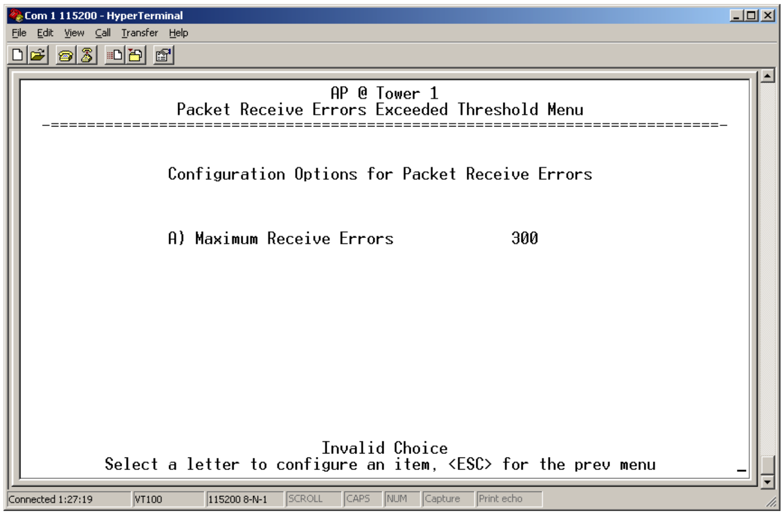


```
                    AP @ Tower 1
      Lack of Associated Remotes Exceeded Threshold Menu
-==========================================================================-

         Configuration Options for Lack of Associated Remotes


         A) Lack of Remotes for              500 seconds






    Select a letter to configure an item, <ESC> for the prev menu
```

Figure 3-77. Lack of Associated Remotes Exceeded Threshold Menu

- **Lack of Remotes for**—Select this item to change the time setting (in seconds) for a lack of associated Remotes. When there are no associated Remotes for a period exceeding this time, a redundancy switchover occurs. [**60-500; 500**]

Packet Receive Errors Exceeded Threshold Menu



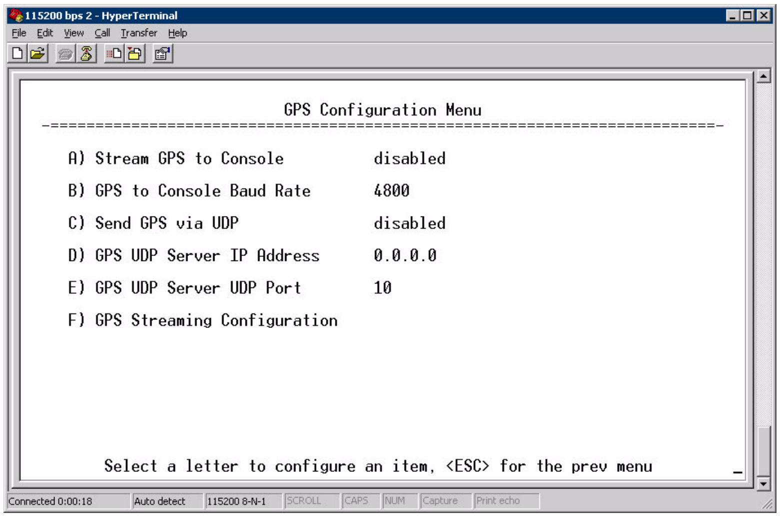
```
                    AP @ Tower 1
        Packet Receive Errors Exceeded Threshold Menu
-==========================================================================-

         Configuration Options for Packet Receive Errors


         A) Maximum Receive Errors           300






                   Invalid Choice
    Select a letter to configure an item, <ESC> for the prev menu         _
```

Figure 3-78. Packet Receive Errors Exceeded Threshold Menu

- **Maximum Receive Errors**—Select this item to change the maximum allowable number of receive errors. When the number of errors exceeds this number, a redundancy switchover occurs. [**0-1000; 500**]

3.9 GPS CONFIGURATION (REMOTE ONLY)

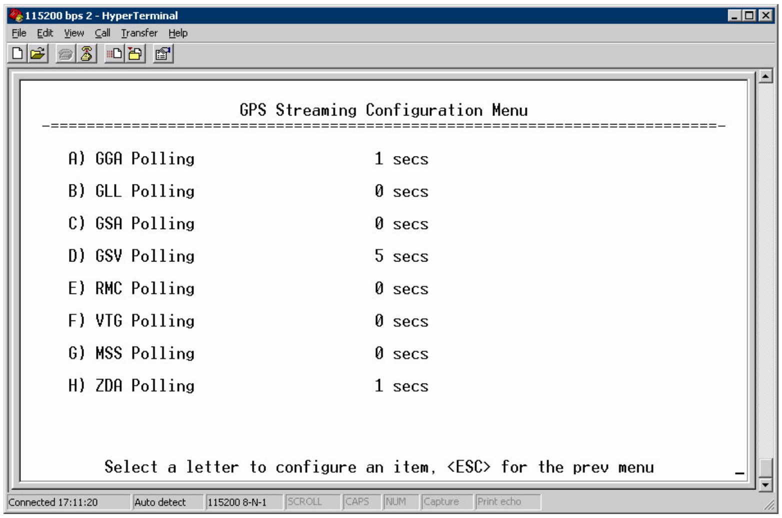
This menu allows you to view or set important parameters for the built-in Global Positioning System (GPS) receiver in the Mercury Remote. Mercury 3650 Remote units do not have or require GPS functionality. Details about the NMEA sentences generated by the GE MDS Mercury can be found at **http://www.nps.gov/gis/gps/NMEA_sentences.html**.



```
                         GPS Configuration Menu
-==========================================================================-

    A) Stream GPS to Console          disabled

    B) GPS to Console Baud Rate       4800

    C) Send GPS via UDP               disabled

    D) GPS UDP Server IP Address      0.0.0.0

    E) GPS UDP Server UDP Port        10

    F) GPS Streaming Configuration





        Select a letter to configure an item, <ESC> for the prev menu
```

Figure 3-79. GPS Configuration Menu (Remote Only)

- **Stream GPS to Console**—Used to enable/disable streaming of GPS NMEA data to the console port (COM1). Baud rate is 4800 baud when Stream GPS to console is enabled. [**enabled, disabled; disabled**]
- **GPS to Console Baud Rate**—The serial baud rate when GPS streaming is enabled.
- **Send GPS via UDP**—Used to enable/disable sending GPS NMEA data to a server via UDP. [**enabled, disabled; disabled**]
- **GPS UDP Server IP Address**—Specify the destination address for GPS NMEA UDP packets. [**any valid IP address; 0.0.0.0**]
- **GPS UDP Server UDP Port**—Destination UDP port for GPS NMEA UDP packets. [**valid UDP port number; 0**]
- **GPS Streaming Configuration**—A submenu for setting GPS NMEA outputs. (See Figure 3-80 on Page 110.)



115200 bps 2 - HyperTerminal
File Edit View Call Transfer Help
Connected 17:11:20 Auto detect 115200 8-N-1 SCROLL CAPS NUM Capture Print echo

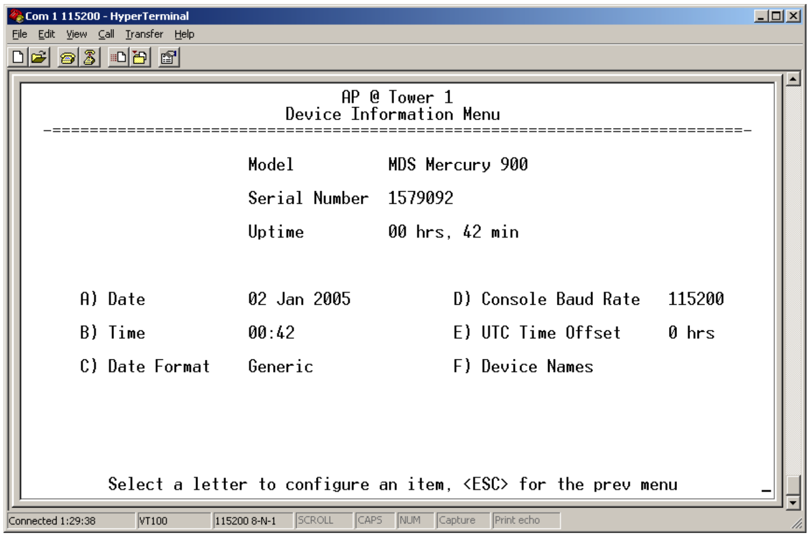
```
                    GPS Streaming Configuration Menu
-===========================================================================-

     A) GGA Polling                    1 secs

     B) GLL Polling                    0 secs

     C) GSA Polling                    0 secs

     D) GSV Polling                    5 secs

     E) RMC Polling                    0 secs

     F) VTG Polling                    0 secs

     G) MSS Polling                    0 secs

     H) ZDA Polling                    1 secs


         Select a letter to configure an item, <ESC> for the prev menu
```

Figure 3-80. GPS Streaming Configuration Menu

- **GGA Polling**—Seconds between GGA string outputs, the satellite fix information.
- **GLL Polling**—Seconds between GLL string outputs, the latitude and longitude information.
- **GSA Polling**—Seconds between GSA string outputs, the overall satellite data.
- **GSV Polling**—Seconds between GSV string outputs, the detailed satellite data.
- **RMC Polling**—Seconds between RMC string outputs, the recommended minimum data.
- **VTG Polling**—Seconds between VTG string outputs, the vector track and speed over ground.
- **MSS Polling**—Seconds between MSS string outputs, the beacon receiver status information.
- **ZDA Polling**—Seconds between ZDA string outputs, data, and time.

3.10 DEVICE INFORMATION MENU

Figure 3-81 shows the menu that displays basic administrative data on the unit to which you are connected. It also provides access to user-specific parameters such as date/time settings and device names.



```
                              AP @ Tower 1
                        Device Information Menu
 -=========================================================================-

                     Model          MDS Mercury 900

                     Serial Number  1579092

                     Uptime         00 hrs, 42 min


    A) Date          02 Jan 2005          D) Console Baud Rate   115200

    B) Time          00:42                E) UTC Time Offset     0 hrs

    C) Date Format   Generic              F) Device Names




       Select a letter to configure an item, <ESC> for the prev menu
```

Figure 3-81. Device Information Menu

- **Model** *(Display only)*
- **Serial Number** *(Display only)*
- **Uptime** *(Display only)*—Elapsed time since boot-up.
- **Date**—Current date being used for the transceiver logs. User-setable. (Value lost with power failure if SNTP [Simple Network Time Protocol] server not accessible.)
- **Time**—Current time of day. User-setable.
  Setting: HH:MM:SS
  (Value lost with power failure if SNTP server not accessible.)
- **Date Format**—Select presentation format:
  - Generic = dd Mmm yyyy
  - European = dd-mm-yyyy
  - US = mm-dd-yyyy
- **Console Baud Rate**—Used to set/display data communications rate (in bits-per-second) between a connected console terminal and the radio. [**115200**]

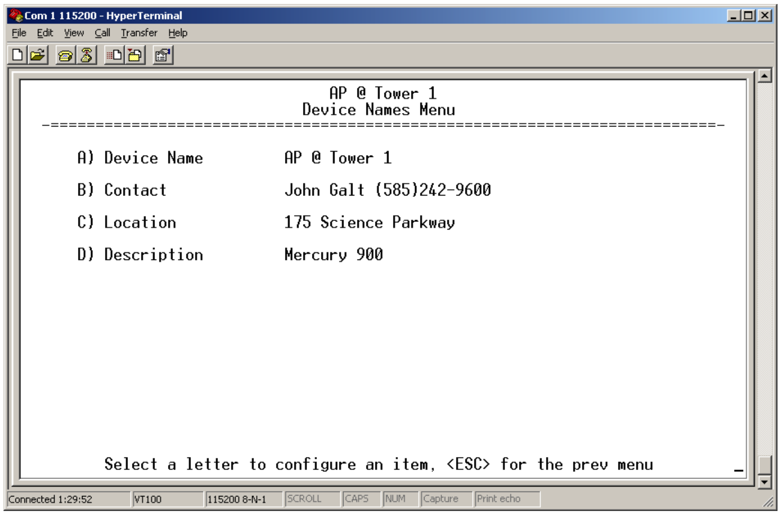
- **UTC Time Offset**—Set/view the number of hours difference between your local clock time and Universal Coordinated Time. Offsets for U.S. times zones are shown in the chart below.

Time Zone (U.S.)	UTC Offset (Hours)
PST	-8
MST	-7
CST	-6
EST	-5

- **Device Names**—Fields used at user's discretion for general administrative purposes. The Device Name field is shown on all menu screen headings. (See Figure 3-82 on Page 112)

NOTE: The transceivers do not save time and date information when power is removed.

Device Names Menu



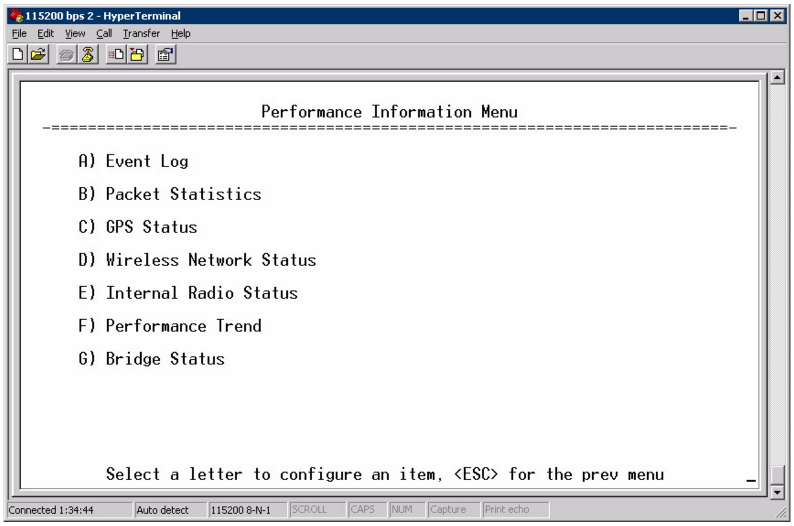
```
                              AP @ Tower 1
                           Device Names Menu
-==========================================================================-

     A) Device Name           AP @ Tower 1

     B) Contact               John Galt (585)242-9600

     C) Location              175 Science Parkway

     D) Description           Mercury 900






        Select a letter to configure an item, <ESC> for the prev menu
```

Figure 3-82. Device Names Menu

- **Device Name**—Used by the transceiver as the "Realm" name for network login (web browser only) and menu headings.
- **Contact**—User defined; appears on this screen only.
- **Location**—User defined; appears on this screen only.
- **Description**—User defined; appears on this screen only.

3.11 PERFORMANCE INFORMATION MENU

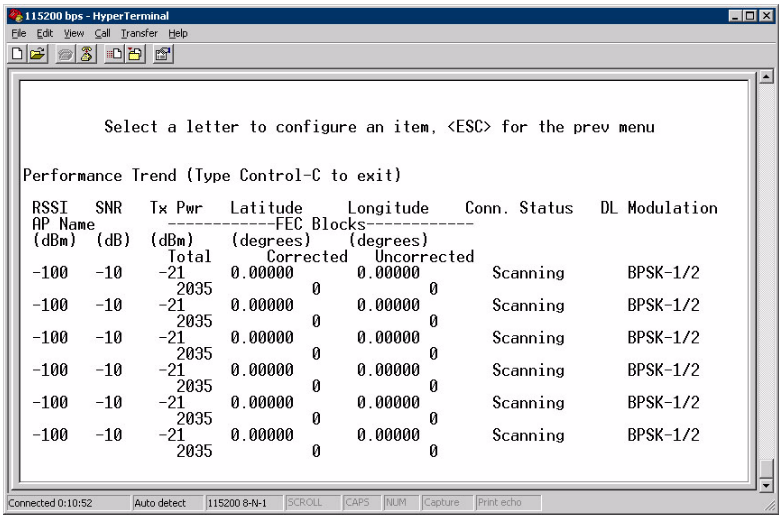
The Performance Information Menu (Figure 3-83 on Page 113) is the entry point for a series of submenus where you can evaluate transceiver operating status and network performance. You can use this menu as an important troubleshooting tool, or for evaluating changes made to the network configuration or equipment.



```
                          Performance Information Menu
-===========================================================================-

    A) Event Log

    B) Packet Statistics

    C) GPS Status

    D) Wireless Network Status

    E) Internal Radio Status

    F) Performance Trend

    G) Bridge Status




       Select a letter to configure an item, <ESC> for the prev menu
```

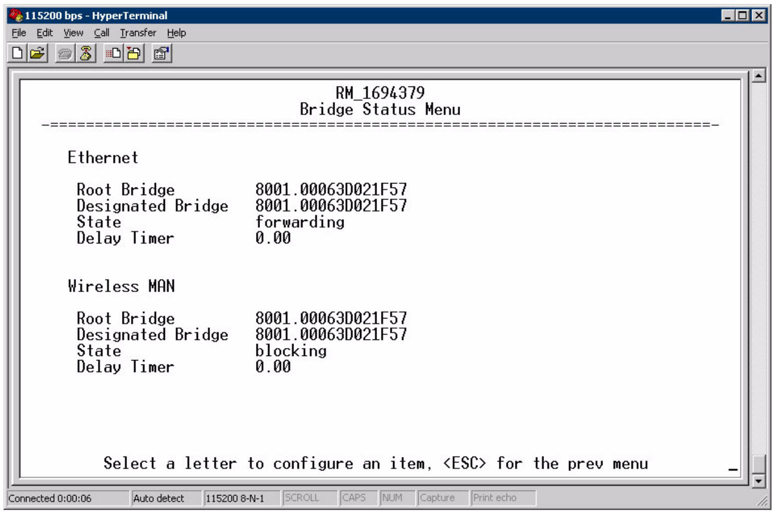
Figure 3-83. Performance Information Menu

- **Event Log**—Access this menu for managing the unit's operational activities log. (See Figure 3-86 on Page 115 for details.)
- **Packet Statistics**—Multiple radio and network operating statistics. (See Figure 3-88 on Page 117 for details.)
- **GPS Status**—Shows satellite fix status, number of satellites being received, and unit location data. (See Figure 3-89 on Page 118 for details.)
- **Wireless Network Status**—Current AP association state and MAC address. (See Figure 3-91 on Page 120 for details.)
- **Internal Radio Status** (Remote Only)—Shows connection status, RF parameters, and total FEC count for the unit. (See Figure 3-96 on Page 122 for details.)
- **Performance Trend** (Remote Only)—Launches a continuously updated list of performance parameters (RSSI, Signal-to-Noise Ratio, Transmit Power, Latitude, Longitude, Connection Status, and FEC Blocks). (See Figure 3-84 on Page 114.)
- **Bridge Status**—Displays the network bridge status. (See Figure 3-85 on Page 114.)



```
        Select a letter to configure an item, <ESC> for the prev menu

Performance Trend (Type Control-C to exit)

 RSSI   SNR   Tx Pwr   Latitude     Longitude    Conn. Status   DL Modulation
 AP Name         ------------FEC Blocks------------
 (dBm)  (dB)  (dBm)    (degrees)    (degrees)
                 Total      Corrected   Uncorrected
 -100   -10    -21     0.00000      0.00000        Scanning       BPSK-1/2
                  2035            0            0
 -100   -10    -21     0.00000      0.00000        Scanning       BPSK-1/2
                  2035            0            0
 -100   -10    -21     0.00000      0.00000        Scanning       BPSK-1/2
                  2035            0            0
 -100   -10    -21     0.00000      0.00000        Scanning       BPSK-1/2
                  2035            0            0
 -100   -10    -21     0.00000      0.00000        Scanning       BPSK-1/2
                  2035            0            0
 -100   -10    -21     0.00000      0.00000        Scanning       BPSK-1/2
                  2035            0            0
```

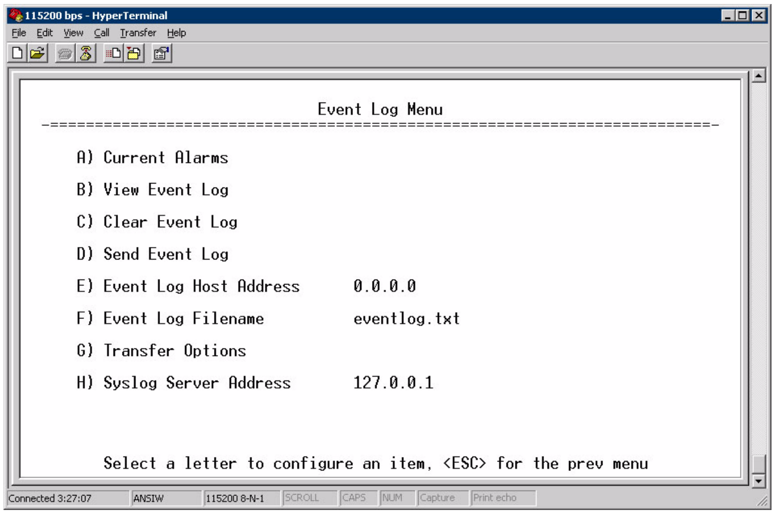
Figure 3-84. Performance Trend Screen



```
                                 RM_1694379
                             Bridge Status Menu
  ===========================================================================

     Ethernet

      Root Bridge          8001.00063D021F57
      Designated Bridge    8001.00063D021F57
      State                forwarding
      Delay Timer          0.00


     Wireless MAN

      Root Bridge          8001.00063D021F57
      Designated Bridge    8001.00063D021F57
      State                blocking
      Delay Timer          0.00



         Select a letter to configure an item, <ESC> for the prev menu   _
```

Figure 3-85. Bridge Status Menu

Event Log Menu

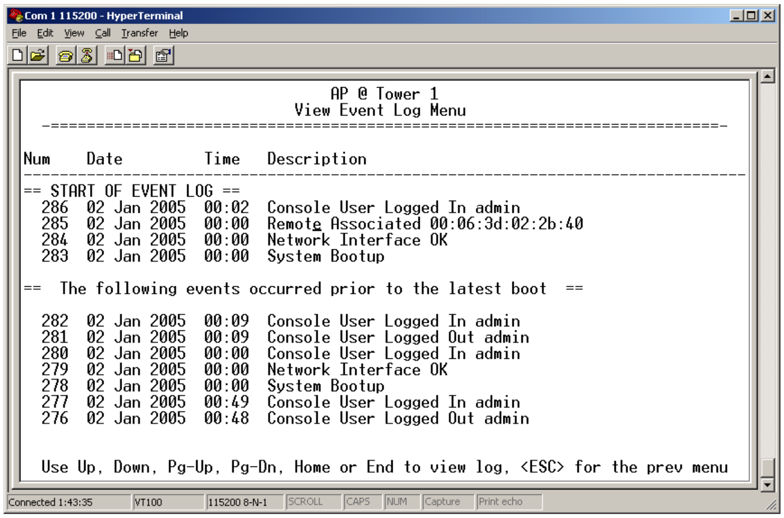


```
                              Event Log Menu
 -=========================================================================-

      A) Current Alarms

      B) View Event Log

      C) Clear Event Log

      D) Send Event Log

      E) Event Log Host Address      0.0.0.0

      F) Event Log Filename          eventlog.txt

      G) Transfer Options

      H) Syslog Server Address       127.0.0.1


         Select a letter to configure an item, <ESC> for the prev menu
```

Figure 3-86. Event Log Menu

- **Current Alarms**—Shows active alarms (if any) reported by the transceiver.
- **View Event Log**—Displays a log of radio events arranged by event number, date, and time. (Example shown in Figure 3-87 on Page 116).
- **Clear Event Log**—Erases all previously logged events.
- **Send Event Log**—Sends the event log to the server. You must answer the challenge question **Send File? y/n** before the request proceeds.
- **Event Log Host Address**—Set/display the IP address of the TFTP server. [**any valid IP address; 0.0.0.0**]
- **Event Log Filename**—Set/display the name of the event log file on the TFTP server. [**any valid filename; eventlog.txt**]
- **Transfer Options**—A menu for configuring the TFTP transfer.
- **Syslog Server Address**—Use this selection to set or view the IP address of the Syslog server. Syslog is a standardized protocol for sending IP log data across a network. Low cost (or even free) Syslog downloads are available online by searching for the term “Syslog Server.” [**any valid IP address; 0.0.0.0**]

View Event Log Menu



```
                              AP @ Tower 1
                          View Event Log Menu
  -==========================================================================-

Num    Date        Time   Description
--------------------------------------------------------------------------------
== START OF EVENT LOG ==
  286  02 Jan 2005  00:02  Console User Logged In admin
  285  02 Jan 2005  00:00  Remote Associated 00:06:3d:02:2b:40
  284  02 Jan 2005  00:00  Network Interface OK
  283  02 Jan 2005  00:00  System Bootup

==  The following events occurred prior to the latest boot  ==

  282  02 Jan 2005  00:09  Console User Logged In admin
  281  02 Jan 2005  00:09  Console User Logged Out admin
  280  02 Jan 2005  00:00  Console User Logged In admin
  279  02 Jan 2005  00:00  Network Interface OK
  278  02 Jan 2005  00:00  System Bootup
  277  02 Jan 2005  00:49  Console User Logged In admin
  276  02 Jan 2005  00:48  Console User Logged Out admin


  Use Up, Down, Pg-Up, Pg-Dn, Home or End to view log, <ESC> for the prev menu
```

Figure 3-87. View Event Log Menu

The transceiver’s microprocessor monitors many operational parameters and logs them. Events are classified into four levels of importance, which are described in Table 3-8. Some of these events result from a condition that prevents normal operation of the unit. These are “critical” events that cause the unit to enter an “alarmed” state and the PWR LED to blink until the condition is corrected. All events are stored in the Event Log..

Table 3-8. Event Classifications

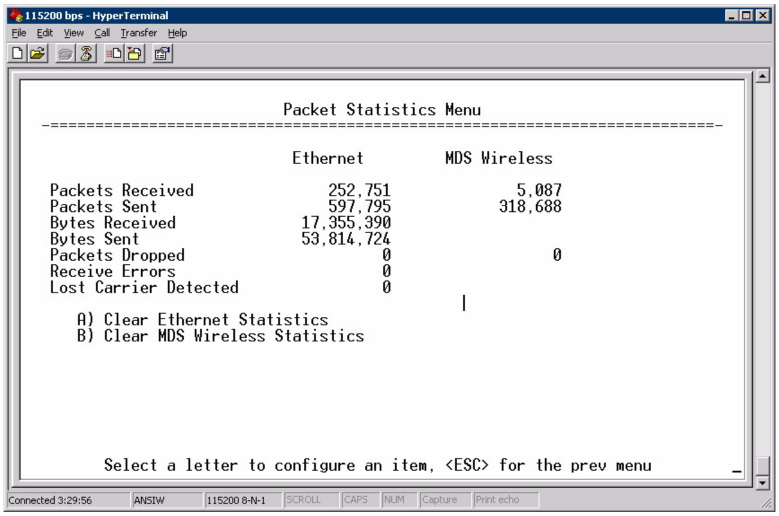
Level	Description/Impact
Informational	Normal operating activities
Minor	Does not affect unit operation
Major	Degraded unit performance but still capable of operation
Critical	Prevents the unit from operating

Time and Date

The events stored in the Event Log are time-stamped using the time and date of the locally connected device. The Access Point obtains the time and date from a Time Server. This server is typically a standard Windows PC server SNTP application. In the absence of the SNTP services, the user must manually enter time and date information at the Access Point. (See *“DEVICE INFORMATION MENU”* on Page 111 for SNTP server identification.) The manually set time and date clock relies on the unit’s primary power. A loss of power resets the clock to **02 Jan 2005** but does not affect previously stored error events.

Packet Statistics Menu

The transceivers maintain running counters of different categories of events in the Ethernet protocol. The Packet Statistics refer to each Ethernet interface from the perspective of the *radio*.

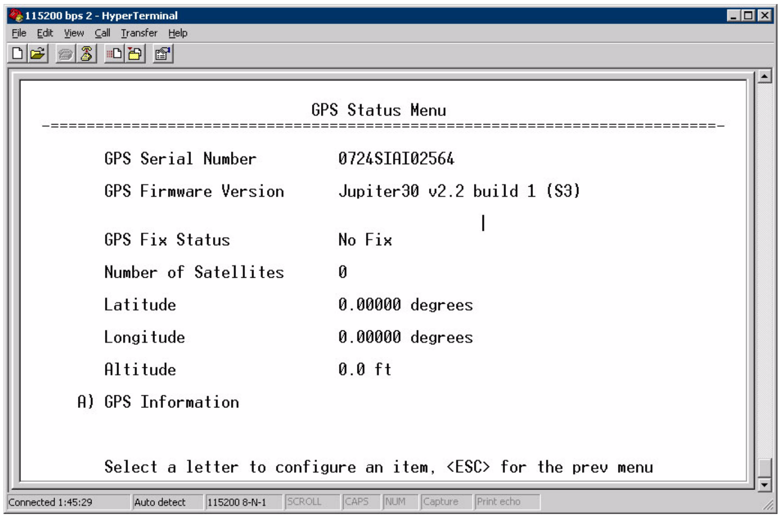


```
                         Packet Statistics Menu
-==========================================================================-

                           Ethernet        MDS Wireless

 Packets Received           252,751             5,087
 Packets Sent               597,795           318,688
 Bytes Received          17,355,390
 Bytes Sent              53,814,724
 Packets Dropped                  0                 0
 Receive Errors                   0
 Lost Carrier Detected            0

    A) Clear Ethernet Statistics
    B) Clear MDS Wireless Statistics





       Select a letter to configure an item, <ESC> for the prev menu
```

Figure 3-88. Packet Statistics Menu

- **Packets Received**—Data packets received by this unit.
- **Packets Sent**—Data packets sent by this unit.
- **Bytes Received**—Data bytes received by this unit.
- **Bytes Sent**—Data bytes sent by this unit.
- **Packets Dropped**—To-be-transmitted packets dropped because of a lack of buffers in the outbound queue.
- **Receive Errors**—Packets that do not pass CRC. This may be due to transmissions corrupted by RF interference, Ethernet collisions, or degradation. If significant Ethernet Receive Errors are observed, check the quality of your Ethernet cabling and connectors, or that you do not have cable lengths exceeding the specification limits.
- **Lost Carrier Detected**—This parameter reports how many times the wired Ethernet connection has lost link.
- **Clear Ethernet Statistics**—Resets the statistics counter. You must answer the challenge question **Send File? y/n** before the request proceeds.
- **Clear MDS Wireless Statistics**—Resets the statistics counter. You must answer the challenge question **Send File? y/n** before the request proceeds.

GPS Status Menu

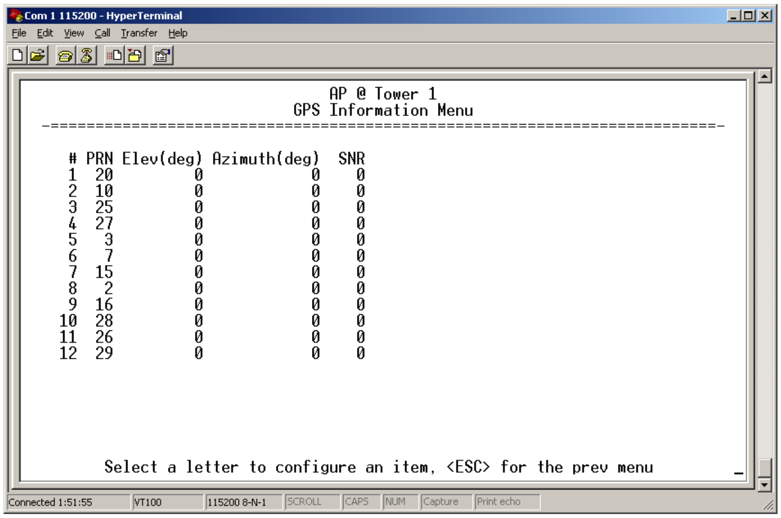


```
                              GPS Status Menu
-==========================================================================-

       GPS Serial Number         0724SIAI02564
       GPS Firmware Version      Jupiter30 v2.2 build 1 (S3)

       GPS Fix Status            No Fix
       Number of Satellites      0
       Latitude                  0.00000 degrees
       Longitude                 0.00000 degrees
       Altitude                  0.0 ft
    A) GPS Information


       Select a letter to configure an item, <ESC> for the prev menu
```

Figure 3-89. GPS Status Menu

- **GPS Serial Number**—The serial number of the GPS unit in the radio.
- **GPS Firmware Version**—The firmware version running on the GPS chip.
- **Satellite Fix Status**—Indicates whether or not the unit has achieved signal lock with the minimum required number of GPS satellites. The transceiver requires a fix on five satellites to achieve Precise Positioning Service (PPS) and four to maintain PPS. [**No Fix, Fix**]
- **Number of Satellites**—Shows the number of GPS satellites received by the transceiver. Although there are typically 24 active GPS satellites orbiting the Earth twice a day, only a subset of these is "visible" to a receiver at a given location. A good signal provides information from six to ten satellites.
- **Latitude**—Shows the transceiver's latitudinal location (in degrees), based on GPS data received from the satellites.
- **Longitude**—Shows the transceiver's longitudinal location (in degrees), based on GPS data received from the satellites.
- **Altitude**—Shows the transceiver's altitude above sea level (in feet), based on GPS data received from the satellites.
- **GPS Information**—Shows data about the individual satellites being received, including the Pseudo-Random Noise (PRN) code (a unique bit stream for each satellite), the satellite's elevation (in degrees), azimuth (in degrees), and the signal-to-noise ratio of the carrier signal (SNR). Figure 3-90 on Page 119 shows a layout example for this screen.

GPS Information Menu



```
                              AP @ Tower 1
                          GPS Information Menu
  -==========================================================================-

     # PRN Elev(deg) Azimuth(deg)  SNR
     1  20         0           0    0
     2  10         0           0    0
     3  25         0           0    0
     4  27         0           0    0
     5   3         0           0    0
     6   7         0           0    0
     7  15         0           0    0
     8   2         0           0    0
     9  16         0           0    0
    10  28         0           0    0
    11  26         0           0    0
    12  29         0           0    0




        Select a letter to configure an item, <ESC> for the prev menu
```

Figure 3-90. GPS Information Menu

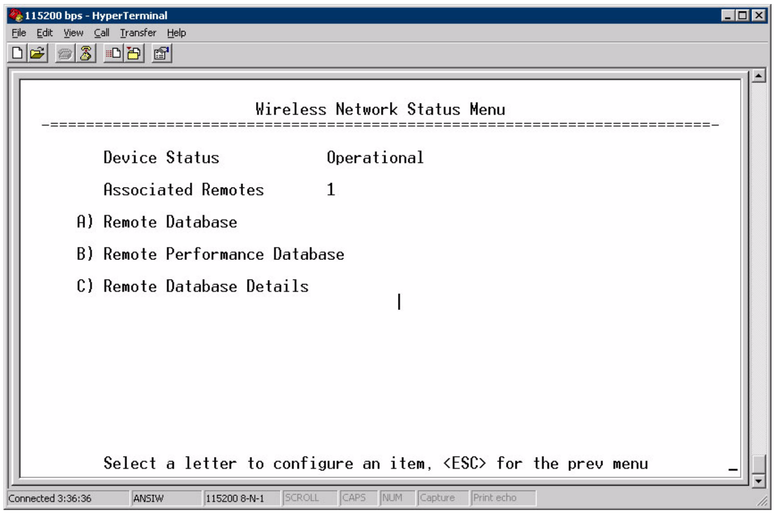
Wireless Network Status Menu

The Wireless Network Status screen provides information on a key operating process of the transceiver—the association of the Remote with the Access Point. The following is a description of how this process takes place and is monitored by the menu system.

The Transceiver□s Association Process

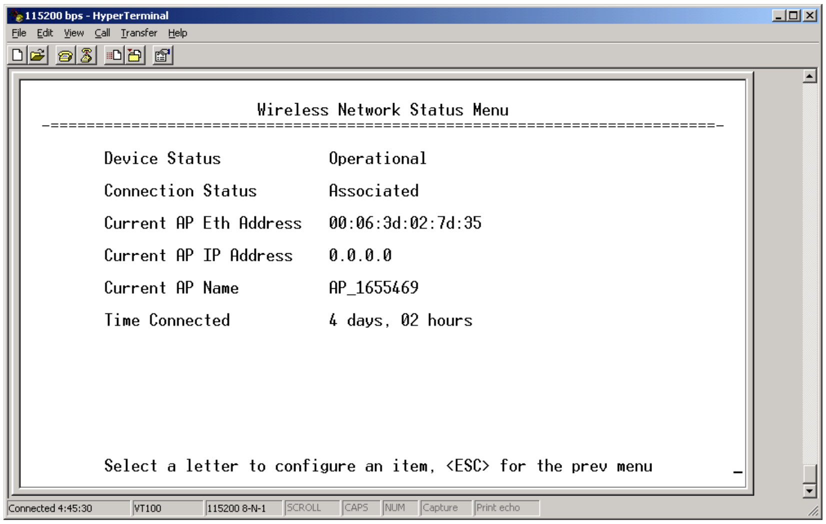
If the Access Point and Remote are configured for single channel operation, the Remote monitors the channel for Access Point transmissions. The Remote synchronizes its power, timing, and frequency to the Access Point, then requests access to the network. The Access Point and Remote check each other’s authorization and authentication according to the configuration of the **Device Authorization** and **Encryption Enable** parameters, and the **Network Name** parameter. The Remote is then associated.

If the Access Point and Remote are configured for frequency hopping, the Remote hops with the Access Point according to Access Point’s configuration. Once the Remote is hopping in sync with the Access Point, the rest of the association process is the same as for single channel operation.



```
                         Wireless Network Status Menu
 -==========================================================================-

       Device Status              Operational

       Associated Remotes         1

    A) Remote Database

    B) Remote Performance Database

    C) Remote Database Details



       Select a letter to configure an item, <ESC> for the prev menu
```

Figure 3-91. Wireless Network Status Menu (AP)

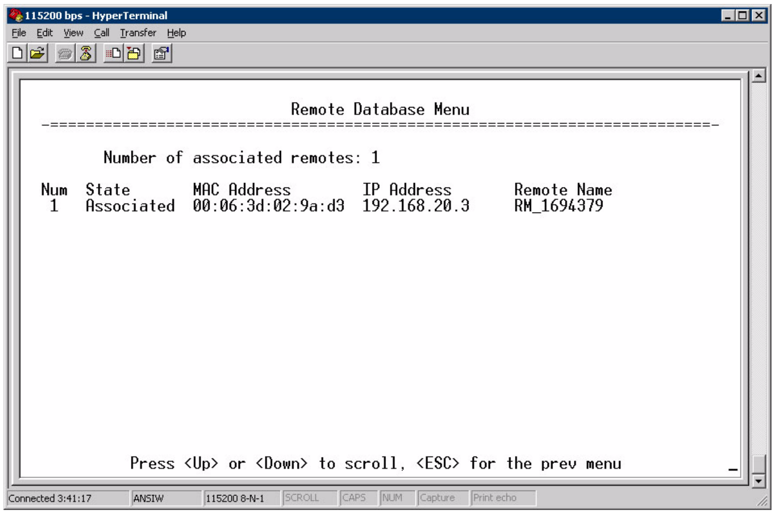


```
                         Wireless Network Status Menu
 -==========================================================================-

       Device Status              Operational

       Connection Status          Associated

       Current AP Eth Address     00:06:3d:02:7d:35

       Current AP IP Address      0.0.0.0

       Current AP Name            AP_1655469

       Time Connected             4 days, 02 hours



       Select a letter to configure an item, <ESC> for the prev menu
```

Figure 3-92. Wireless Network Status Menu (Remote)

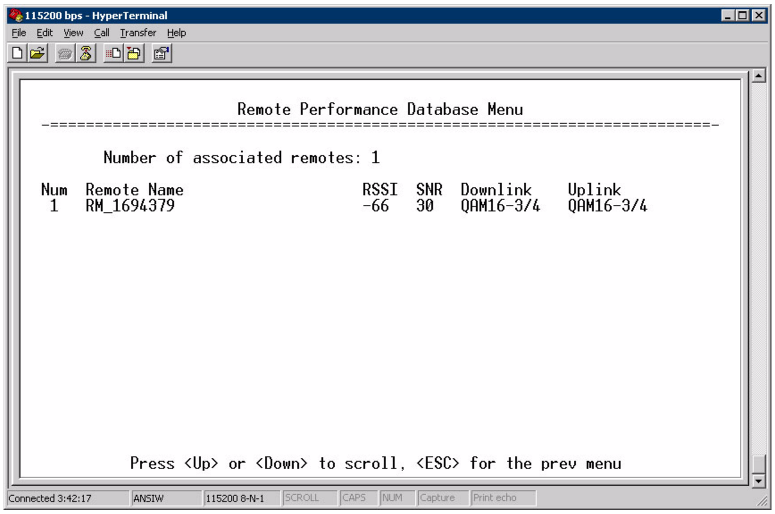
- **Device Status**—Displays the overall operating condition of the transceiver. [**Operational, Alarmed**]
- **Associated Remotes** (AP Only)—Shows the number of Remote transceivers currently associated with the AP.
- **Remote Database** (AP Only)—Displays a submenu where associated Remotes are listed in table form according to their number, operational state, MAC address, IP address, and name (if assigned). (See Figure 3-93 on Page 121.)
- **Remote Performance Database** (AP Only)—Displays a submenu where associated Remote performance data is listed in table form. Remotes are presented according to their number, MAC address, RSSI, SNR, modulation type, and FEC total. (See Figure 3-94 on Page 121.)

- **Connection Status** (Remote Only)—Displays the current state of the wireless network communication as follows: **Scanning, Ranging, Connecting, Authenticating, Associated,** or **Alarmed.** A complete explanation of these operating states is provided in Table 4-3 on Page 154.
- **Current AP Eth Address**—Displays the Ethernet MAC address of the current AP.
- **Current AP IP Address**—Shows the IP address of the current AP.
- **Current AP Name**—Displays the device name of the current AP.
- **Time Connected**—Shows the time at which the remote connected to the AP. The Remote has been continually connected since this time.



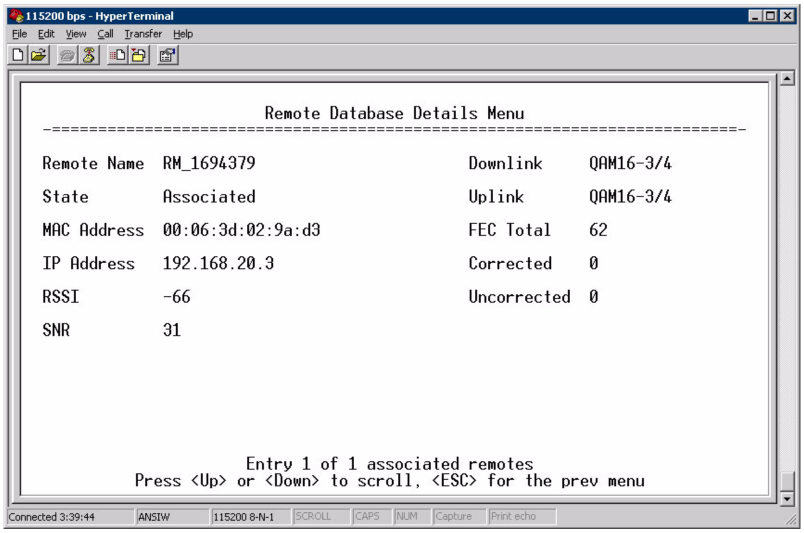
```
                         Remote Database Menu
-==========================================================================-

       Number of associated remotes: 1

Num  State       MAC Address        IP Address       Remote Name
 1   Associated  00:06:3d:02:9a:d3  192.168.20.3     RM_1694379

          Press <Up> or <Down> to scroll, <ESC> for the prev menu
```

Figure 3-93. Remote Database Menu



```
                   Remote Performance Database Menu
-==========================================================================-

       Number of associated remotes: 1

Num  Remote Name                     RSSI  SNR  Downlink    Uplink
 1   RM_1694379                      -66   30   QAM16-3/4   QAM16-3/4

          Press <Up> or <Down> to scroll, <ESC> for the prev menu
```

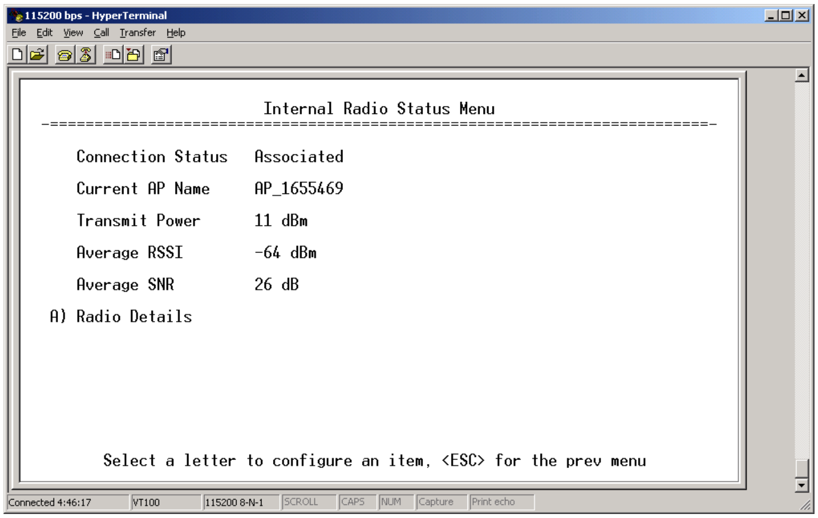
Figure 3-94. Remote Performance Database Menu



```
                        Remote Database Details Menu
-==========================================================================-

Remote Name   RM_1694379                          Downlink     QAM16-3/4

State         Associated                          Uplink       QAM16-3/4

MAC Address   00:06:3d:02:9a:d3                   FEC Total    62

IP Address    192.168.20.3                        Corrected    0

RSSI          -66                                 Uncorrected  0

SNR           31




                      Entry 1 of 1 associated remotes
           Press <Up> or <Down> to scroll, <ESC> for the prev menu
```

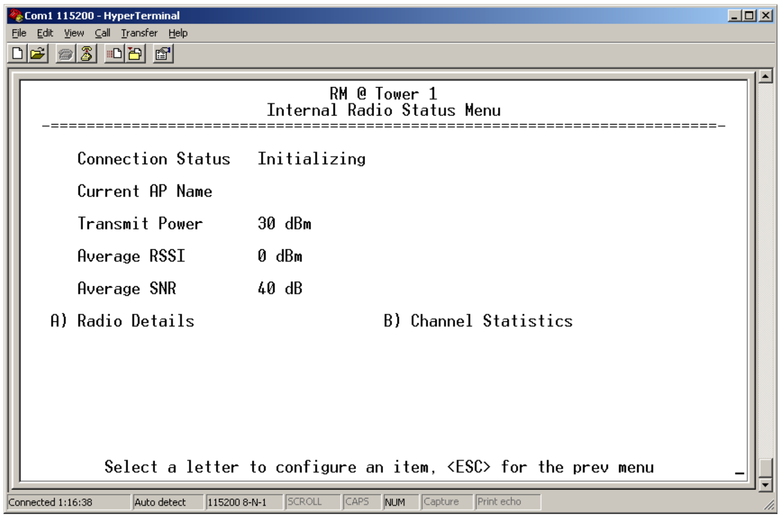
Figure 3-95. Remote Database Details Menu (AP)

Internal Radio Status Menu (Remote Only)



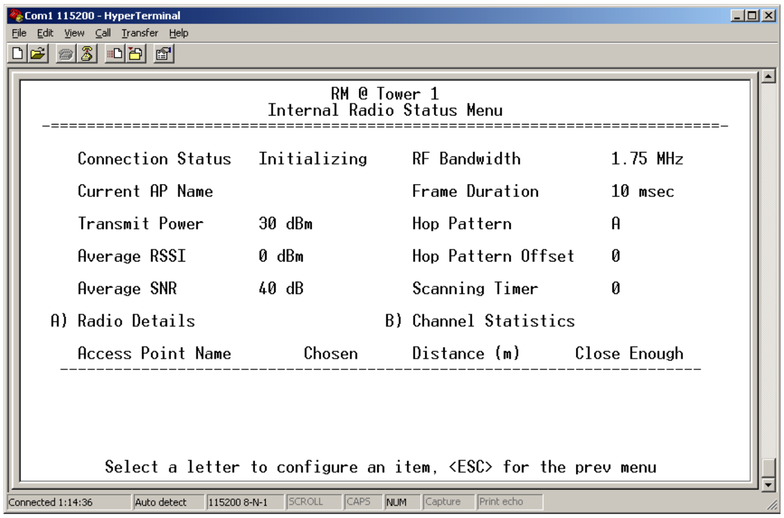
```
                          Internal Radio Status Menu
-========================================================================-

     Connection Status    Associated

     Current AP Name      AP_1655469

     Transmit Power       11 dBm

     Average RSSI         -64 dBm

     Average SNR          26 dB

  A) Radio Details





          Select a letter to configure an item, <ESC> for the prev menu
```

Figure 3-96. Internal Radio Status (Remote Only)



```
                          RM @ Tower 1
                   Internal Radio Status Menu
-=========================================================================-

    Connection Status   Initializing

    Current AP Name

    Transmit Power      30 dBm

    Average RSSI        0 dBm

    Average SNR         40 dB

 A) Radio Details                   B) Channel Statistics







      Select a letter to configure an item, <ESC> for the prev menu
```

Figure 3-97. Internal Status Menu
(Remote in Static Hopping mode)



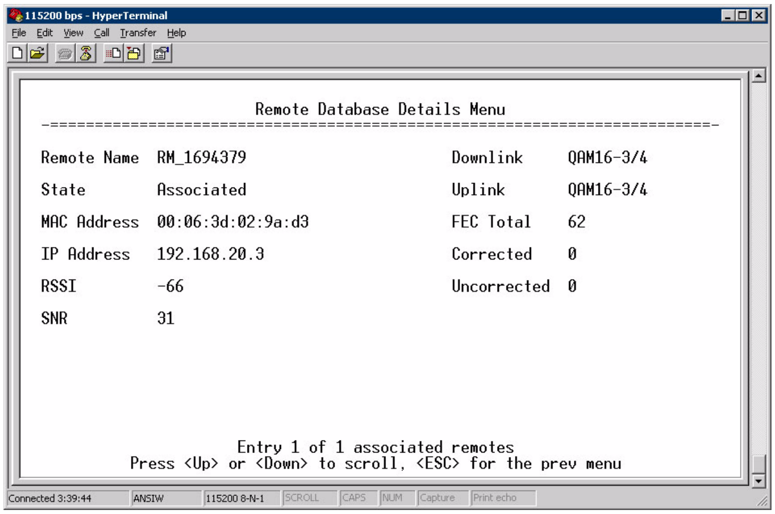
```
                          RM @ Tower 1
                   Internal Radio Status Menu
-=========================================================================-

    Connection Status   Initializing     RF Bandwidth          1.75 MHz

    Current AP Name                      Frame Duration        10 msec

    Transmit Power      30 dBm           Hop Pattern           A

    Average RSSI        0 dBm            Hop Pattern Offset    0

    Average SNR         40 dB            Scanning Timer        0

 A) Radio Details                   B) Channel Statistics

    Access Point Name        Chosen      Distance (m)      Close Enough
  ---------------------------------------------------------------------




      Select a letter to configure an item, <ESC> for the prev menu
```

Figure 3-98. Internal Radio Status Menu
(Remote in Hopping with Handoffs Mode)

NOTE: In the menu above, the items in the right hand column are displayed on Remotes only, when they are in Hopping with Handoffs mode. This allows viewing of the settings the Remote is using to connect to each AP in the AP Locations File. See *Frequency Control Menu* on Page 69 for explanations of these items. Exception: The **Scanning Timer** parameter is unique to the screen shown in Figure 3-98, and is explained below.

- **Connection Status**—Indicates whether or not the Remote station has associated with an AP.
  [**Associated, Scanning, Ranging, Connecting, Authorizing**]
- **Current AP Name**—Shows the Device Name of the current AP.

- **Transmit Power**—Shows the RF power output from the transmitter. The AP changes the transmit power of the Remote to match the desired receive power at the APs receiver. This provides end-to-end power control.
- **Average RSSI**—Shows average received signal strength indication (RSSI) of incoming RF signals, displayed in dBm.
- **Average SNR**—Shows average signal-to-noise-ratio (SNR) of received signals, displayed in dB. This is a measurement of the quality of the incoming signal. It is possible for incoming signals to be strong, yet be affected by interference or other noise, resulting in a low SNR. Use this parameter to help determine the actual quality of signals.
- **Scanning Timer**—A timer that runs while the Remote radio tries to connect to a particular AP. Once this timer reaches the Max Scanning Time, the Remote tries to connect to the next AP in the AP Locations File.
- **Radio Details**—This selection presents a screen (Figure 3-99) showing key operating details of the transceiver.
- **Channel Statistics**—This selection presents a screen (Figure 3-100) that shows signal quality on a channel-by-channel basis. Readings are expressed in RSSI dBm and Signal-to-Noise Ratio (SNR) dB, respectively.

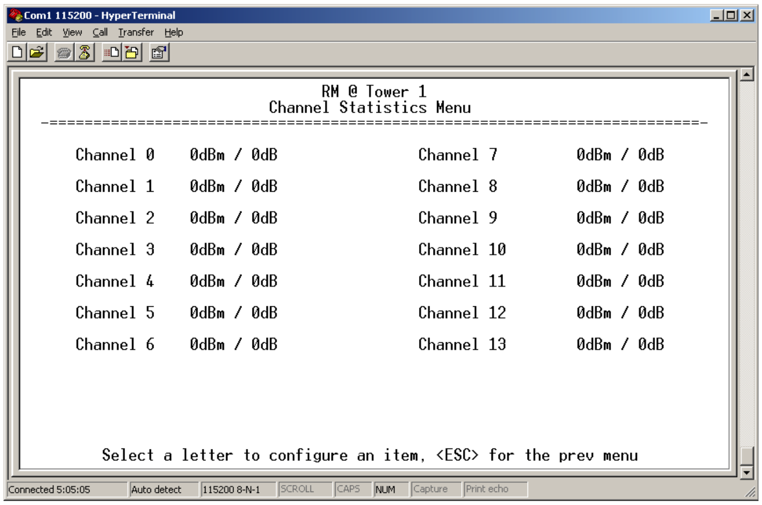


```
                         Remote Database Details Menu
 ========================================================================-

 Remote Name  RM_1694379                          Downlink     QAM16-3/4

 State        Associated                          Uplink       QAM16-3/4

 MAC Address  00:06:3d:02:9a:d3                   FEC Total    62

 IP Address   192.168.20.3                        Corrected    0

 RSSI         -66                                 Uncorrected  0

 SNR          31





                        Entry 1 of 1 associated remotes
           Press <Up> or <Down> to scroll, <ESC> for the prev menu
```

Figure 3-99. Radio Details Menu

- **RSSI**—Shows received signal strength indication (RSSI) in dBm.
- **SNR**—Shows signal-to-noise ratio (SNR) in dB.
- **TX Frequency Offset**—Shows the RF carrier shift of the Remote’s transmitter, measured in Hertz (Hz). The transmitted frequency is continually reviewed and adjusted to agree with what the AP expects to see. This optimization results in more efficient operation, corrects for doppler shift, and results in higher throughput between AP and Remote stations.

- **RX Frequency Offset**—This is a measurement of how far in frequency the Remote’s receiver has shifted (in Hz) to accommodate the incoming signal from the AP.
- **Total FEC Count**—This parameter shows the total number of Forward Error Correction (FEC) blocks handled by the radio.
- **Corrected FEC Count**—Displays the number of errored blocks corrected with FEC by the radio.
- **Uncorrected FEC Count**—Shows the number of errored blocks that can’t be corrected with FEC by the radio.

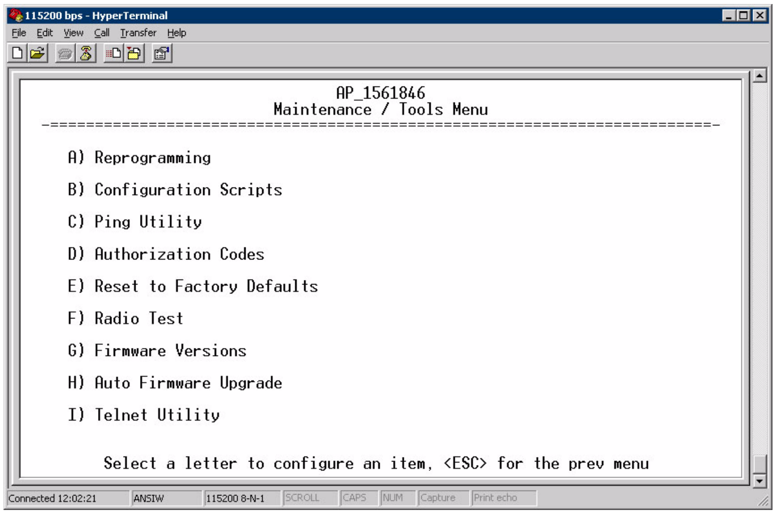


```
                                  RM @ Tower 1
                            Channel Statistics Menu
 -=============================================================================-

     Channel 0     0dBm / 0dB                 Channel 7        0dBm / 0dB

     Channel 1     0dBm / 0dB                 Channel 8        0dBm / 0dB

     Channel 2     0dBm / 0dB                 Channel 9        0dBm / 0dB

     Channel 3     0dBm / 0dB                 Channel 10       0dBm / 0dB

     Channel 4     0dBm / 0dB                 Channel 11       0dBm / 0dB

     Channel 5     0dBm / 0dB                 Channel 12       0dBm / 0dB

     Channel 6     0dBm / 0dB                 Channel 13       0dBm / 0dB




          Select a letter to configure an item, <ESC> for the prev menu
```

Figure 3-100. Channel Statistics Menu

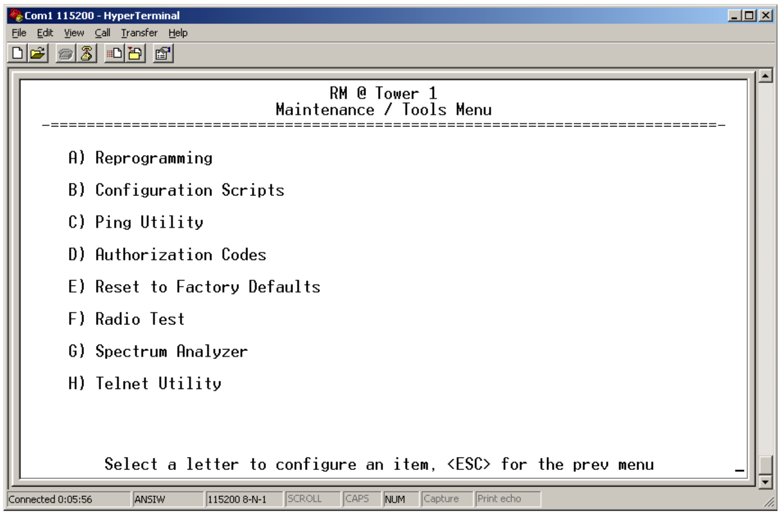
3.12 MAINTENANCE/TOOLS MENU

In the course of operating your network, you may wish to upgrade transceiver firmware to take advantage of product improvements, work with configuration scripts, conduct “ping” tests of your system, or reset operating parameters to factory default settings. All of these tasks are performed using the *Maintenance/Tools Menu* (Figure 3-101). This section explains how to take advantage of these services.



```
                              AP_1561846
                        Maintenance / Tools Menu
-==========================================================================-

     A) Reprogramming

     B) Configuration Scripts

     C) Ping Utility

     D) Authorization Codes

     E) Reset to Factory Defaults

     F) Radio Test

     G) Firmware Versions

     H) Auto Firmware Upgrade

     I) Telnet Utility

         Select a letter to configure an item, <ESC> for the prev menu
```

Figure 3-101. Maintenance/Tools Menu (AP)



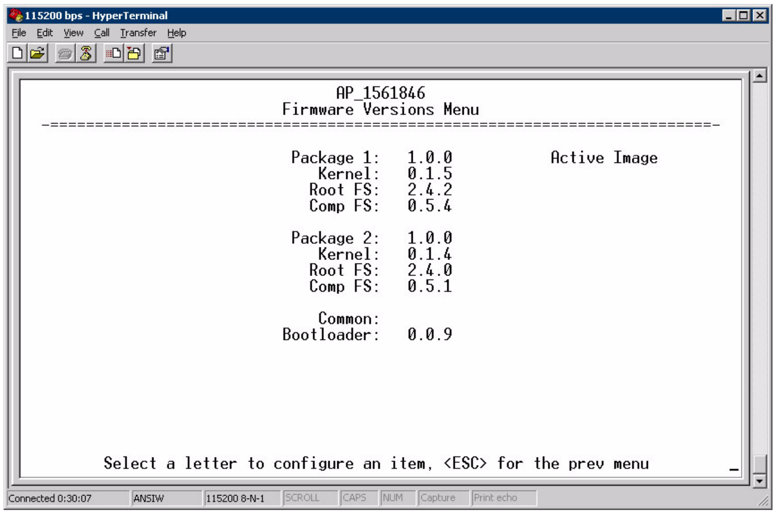
```
                              RM @ Tower 1
                        Maintenance / Tools Menu
-==========================================================================-

     A) Reprogramming

     B) Configuration Scripts

     C) Ping Utility

     D) Authorization Codes

     E) Reset to Factory Defaults

     F) Radio Test

     G) Spectrum Analyzer

     H) Telnet Utility


         Select a letter to configure an item, <ESC> for the prev menu
```

Figure 3-102. Maintenance/Tools Menu (Remote)

(Some versions may show a □Scheduled Reboot□ option, described below)

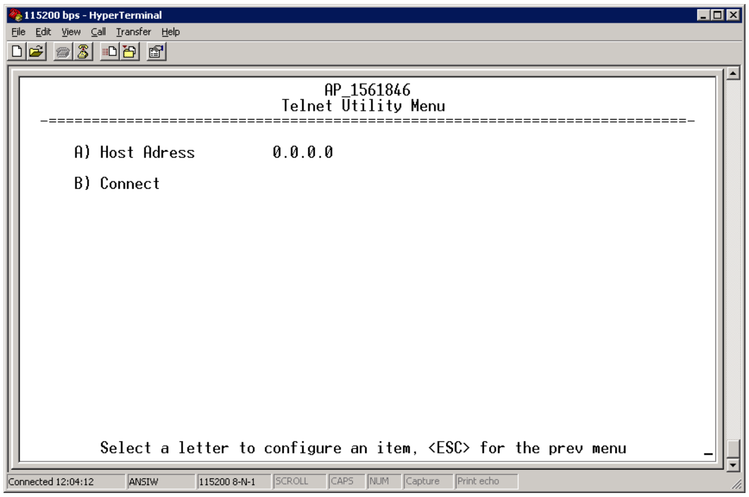
- **Reprogramming**—Managing and selecting the unit's operating system firmware resources. *(See "Reprogramming Menu"* on Page 128*)*
- **Configuration Scripts**—Saving and importing data files containing unit operating parameters/settings. *(See "Configuration Scripts Menu"* on Page 133*)*
- **Ping Utility**—Diagnostic tool to test network connectivity. (See *"Ping Utility Menu"* on Page 137)
- **Authorization Codes**—Alter the unit's overall capabilities by enabling the built-in resources. (*See "Authorization Codes"* on Page 138*)*
- **Reset to Factory Defaults**—Restores parameters to factory default settings. (See *"Reset to Factory Defaults"* on Page 139)

- **Radio Test**—A diagnostic tool for testing RF operation. (See *“Radio Test Menu”* on Page 140)
- **Firmware Versions**—Shows the firmware code versions stored in the radio and indicates which one is the active image. (See Figure 3-103 on Page 127.)
- **Auto Firmware Upgrade**—Brings up a submenu where you can perform tasks related to loading new firmware. (See *“ Auto Firmware Upgrade Menu (AP Only)”* on Page 140.)
- **Telnet Utility**—A submenu for opening Telnet connections to network devices (Figure 3-104 on Page 127).



```
                              AP_1561846
                        Firmware Versions Menu
-===========================================================================-

                        Package 1:   1.0.0          Active Image
                           Kernel:   0.1.5
                          Root FS:   2.4.2
                          Comp FS:   0.5.4

                        Package 2:   1.0.0
                           Kernel:   0.1.4
                          Root FS:   2.4.0
                          Comp FS:   0.5.1

                           Common:
                       Bootloader:   0.0.9



         Select a letter to configure an item, <ESC> for the prev menu
```

Figure 3-103. Firmware Versions Menu



```
                              AP_1561846
                          Telnet Utility Menu
-===========================================================================-

    A) Host Adress           0.0.0.0

    B) Connect



         Select a letter to configure an item, <ESC> for the prev menu
```

Figure 3-104. Telnet Utility Menu

- **Host Address**—The IP address of the target device.
- **Connect**—Connect to the target device at the host address.

Reprogramming Menu

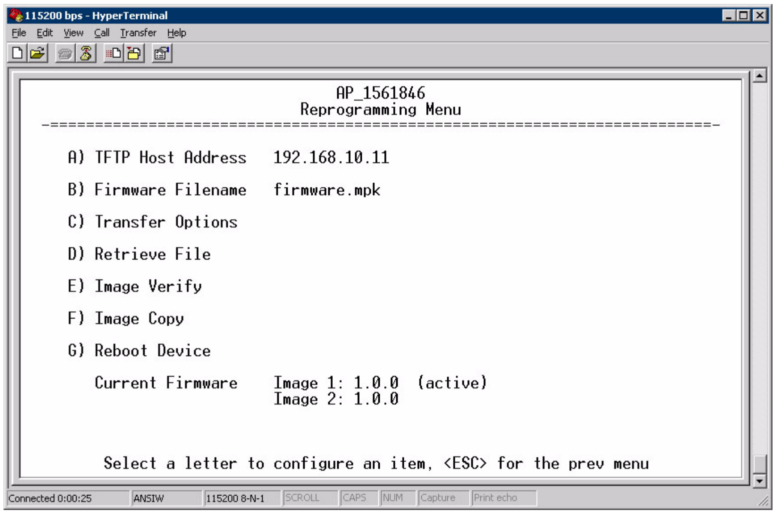
The factory sometimes offers upgrades to the transceiver firmware. Loading new firmware into the unit will not alter any privileges provided by Authorization Keys and does *not* require you to take the transceiver off-line until you want to operate the unit with the newly installed firmware image.

Firmware images are available free-of-charge at:
www.GEmds.com/Resources/TechnicalSupport/

NOTE: Always read the release notes for downloaded firmware. These notes contain important information on compatibility and any special steps needed for proper installation.

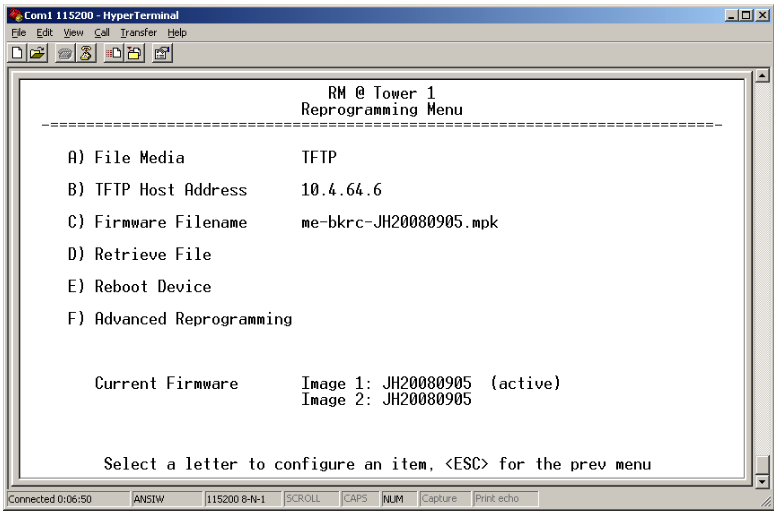
All units and versions have two resident images. Version 1.4.4 had two.mpk files, one for the Access Point and one for the Remote. As of version 2.1.0, there is only one mpk file which you can use with both Access Points and Remotes.

The transceiver has two copies of the firmware (microprocessor code) used for the operating system and applications. One copy is "active" and the second is standing by, ready to be used once activated. You can load new firmware into the inactive position and place it in service whenever you desire.



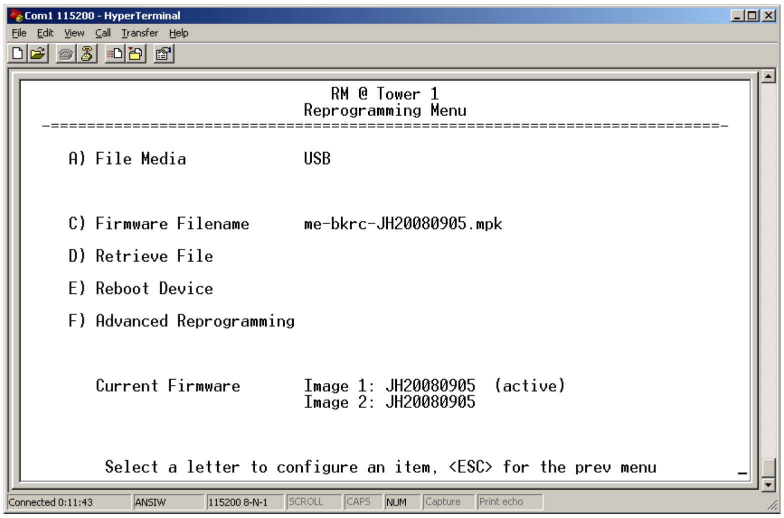
```
                              AP_1561846
                          Reprogramming Menu
 -=============================================================================-

    A) TFTP Host Address   192.168.10.11

    B) Firmware Filename   firmware.mpk

    C) Transfer Options

    D) Retrieve File

    E) Image Verify

    F) Image Copy

    G) Reboot Device

       Current Firmware    Image 1: 1.0.0  (active)
                           Image 2: 1.0.0


        Select a letter to configure an item, <ESC> for the prev menu
```

Figure 3-105. Reprogramming Menu (AP)



```
                          RM @ Tower 1
                       Reprogramming Menu
-========================================================================-

   A) File Media            TFTP

   B) TFTP Host Address     10.4.64.6

   C) Firmware Filename     me-bkrc-JH20080905.mpk

   D) Retrieve File

   E) Reboot Device

   F) Advanced Reprogramming


      Current Firmware      Image 1: JH20080905  (active)
                            Image 2: JH20080905


       Select a letter to configure an item, <ESC> for the prev menu
```

Figure 3-106. Reprogramming Menu
(Remote with WiFi only)



```
                          RM @ Tower 1
                       Reprogramming Menu
-========================================================================-

   A) File Media            USB


   C) Firmware Filename     me-bkrc-JH20080905.mpk

   D) Retrieve File

   E) Reboot Device

   F) Advanced Reprogramming


      Current Firmware      Image 1: JH20080905  (active)
                            Image 2: JH20080905


       Select a letter to configure an item, <ESC> for the prev menu   _
```

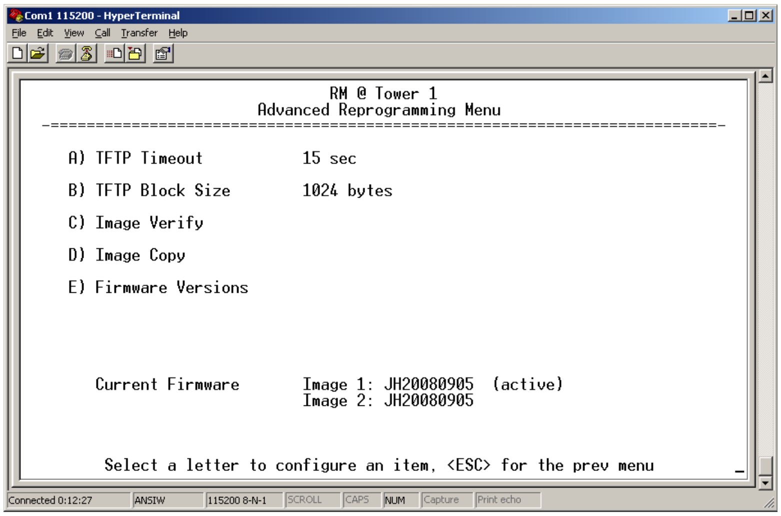
Figure 3-107. Reprogramming Menu
(Remote with WiFi only)

File Media—A selection of methods for transferring files to and from the radio. On firmware version 3.0 radios, the options are **TFTP** and **USB**.

- **TFTP Host Address**—IP address of the host computer from which to get the file. [**Any valid IP address**] This same IP address is used in other screens/functions (reprogramming, logging, etc.). Changing it here also changes it for other screens/functions.
- **Firmware Filename**—Name of file to be received by the TFTP server. [**Any 40-character alphanumeric string**] Verify that this corresponds to the TFTP directory location. May require sub-directory, for example: **me-bkrc-2_1_0.mpk**.
- **Transfer Options**—A menu for configuring the TFTP transfer.

- **Retrieve File**—Initiates the file transfer from the TFTP server. The new file is placed into inactive firmware image. [**Y, N**]
- **Image Verify**—Initiate the verification of the integrity of firmware file held in unit.
- **Image Copy**—Initiate the copying of the active firmware into the inactive image.
- **Reboot Device**—Initiates rebooting of the *transceiver*. This will interrupt data traffic through this unit, and the network if performed on an Access Point. Intended to be used for switching between firmware images 1 and 2.
- **Advanced Reprogramming**—Advanced configuration options for TFTP transfer of firmware files. See Figure 3-108 and related text descriptions.
- **Current Firmware**—Displays the versions of firmware images installed in the transceiver and shows whether Image 1 or Image 2 is currently active.

NOTE: See *Upgrade Procedure* on Page 132 for details on setting up the TFTP server.



```
                              RM @ Tower 1
                        Advanced Reprogramming Menu
 -==========================================================================-

     A) TFTP Timeout          15 sec

     B) TFTP Block Size       1024 bytes

     C) Image Verify

     D) Image Copy

     E) Firmware Versions



        Current Firmware      Image 1: JH20080905  (active)
                              Image 2: JH20080905


         Select a letter to configure an item, <ESC> for the prev menu
```

Figure 3-108. Advanced Reprogramming Menu

- **TFTP Timeout**—View/set the time (in seconds) where no activity results in a TFTP timeout condition.
- **TFTP Block Size**—The data size of each TFTP block being transferred to the radio during firmware upgrade.
- **Image Verify**—Initiate the verification of the integrity of firmware file held in unit.
- **Image Copy**—Initiate the copying of the active firmware into the inactive image.
- **Firmware Versions**—Shows the available versions of firmware code for operation of the radio.

3.12.1 Installing Firmware via TFTP

Firmware images are available free-of-charge at:
www.GEmds.com/Resources/TechnicalSupport/.

NOTE: You may not install AP firmware in Remote radios, or vice-versa. This was only possible for early (pre-version 2.1.0) firmware.

To install firmware by TFTP, you need:

- A PC with a TFTP server running
- The IP address of the PC running the TFTP server
- A valid firmware file

The IP address of the radio can be found under the Management System's **Starting Information Screen**. (See *"Starting Information Screen"* on Page 42.)

A TFTP server is available on the GE MDS Web site at:
www.GEmds.com/Resources/TechnicalSupport/.

TIP: If you do not know your computer's address on a Windows PC, you can use the **RUN** function from the **Start** menu and enter **winipcfg** or **ipconfig** to determine your local PC's IP address.

There are several alternatives to connecting the transceiver for firmware upgrades. Figure 3-109 and Figure 3-110 show two variations. It is essential that all equipment be on the same subnet.

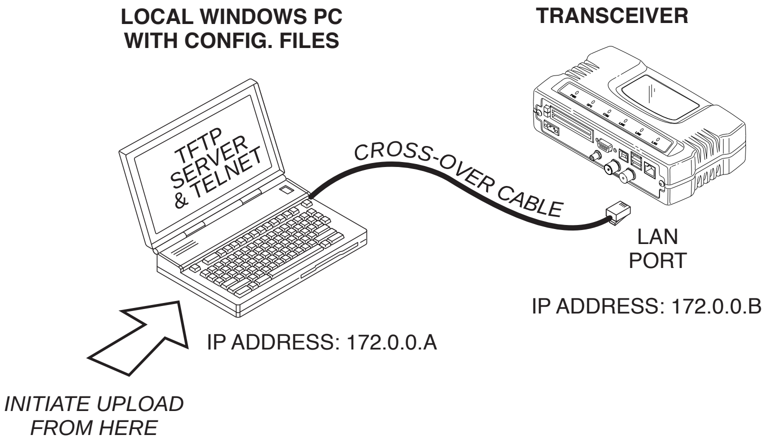


Figure 3-109. Firmware Upgrade Setup□Option 1
(TFTP Server and Firmware File on Same CPU)

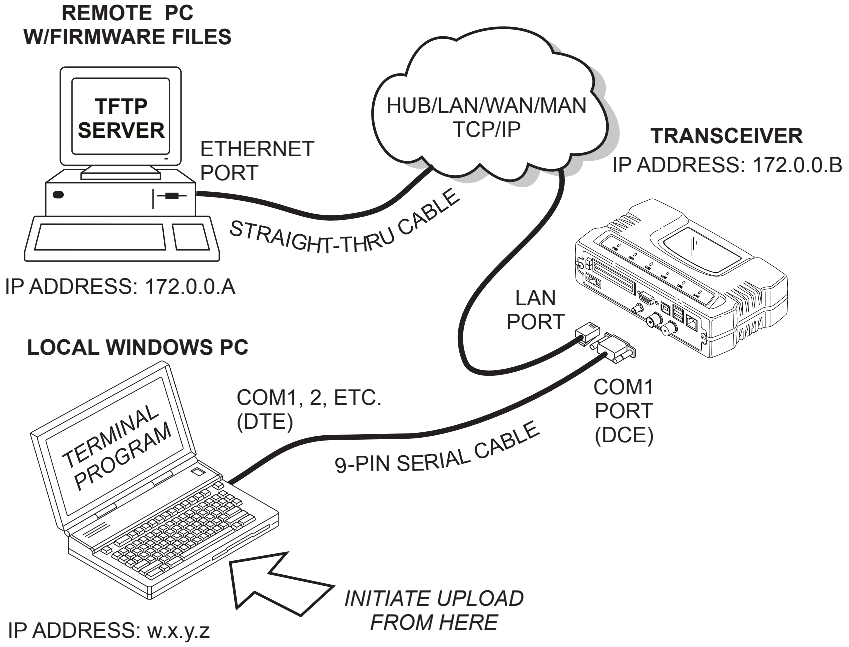


Figure 3-110. Firmware Upgrade Setup Option 2
(TFTP Server and Firmware File on Remote Server)

NOTE: The LAN and COM1 ports share a common data channel when loading firmware over-the-air. Transferring the radio firmware image file (≈ 6 MB) might take several minutes depending on traffic between the TFTP server and the transceiver.

Regardless of your connection to the transceiver, loading firmware/configuration files into the unit's flash memory is much slower than loading software onto a PC hard drive or RAM.

Upgrade Procedure

To load a new firmware file (**filename.mpk**) into the transceiver, use the following procedure:

1. Launch a TFTP server on a PC connected either directly or via a LAN to the Ethernet port (LAN) of the radio. Point the server towards the directory containing the firmware image file.

2. Connect to the Management System by whichever means is convenient: browser or Telnet via the LAN, or Terminal emulator via the COM1 port.

3. Go to the MS Reprogramming Menu.
(**Main Menu>>Maintenance Menu>>Reprogramming Menu**)

4. Fill in the information for the:

   - **TFTP Host Address**—IP Address of server (host computer) running TFTP server.
   - **Firmware Filename**—Name of file (**filename.mpk)** to be downloaded from the TFTP server holding the firmware file.

5. Download the firmware file from the TFTP server into the transceiver.
   (**Main Menu>>Maintenance Menu>>Reprogramming Menu>>Retrieve File**)

   Status messages on the transfer are posted on the Management System screen.

NOTE: The new firmware image file that replaces the "Inactive Image" file is automatically verified.

6. Reboot the transceiver.
   Main Menu>>Maintenance Menu>>Reprogramming Menu>>Reboot Device

7. Test the transceiver for normal operation.

End of Procedure

Error Messages During File Transfers

It is possible to encounter errors during a file transfer. In most cases, these can be corrected by performing the actions described in Table 3-9.

Table 3-9. Common Errors During TFTP Transfer

Error Message	Likely Cause/Corrective Action
Invalid File Type	Indicates that the file is not a valid firmware file. Locate proper file and re-load.
File not found	Invalid or non-existent filename on TFTP server.
Invalid file path	Invalid or non-existent file path to TFTP server.
Timeout	TFTP transfer time expired. Increase the timeout value.
Flash Error	Flash memory error. Contact factory for assistance.
Bad CRC	Cyclic Redundancy Check reporting a corrupted file. Attempt to re-load, or use a different file.
Version String Mismatch	Invalid file detected. Attempt to re-load, or use a different file.

Configuration Scripts Menu

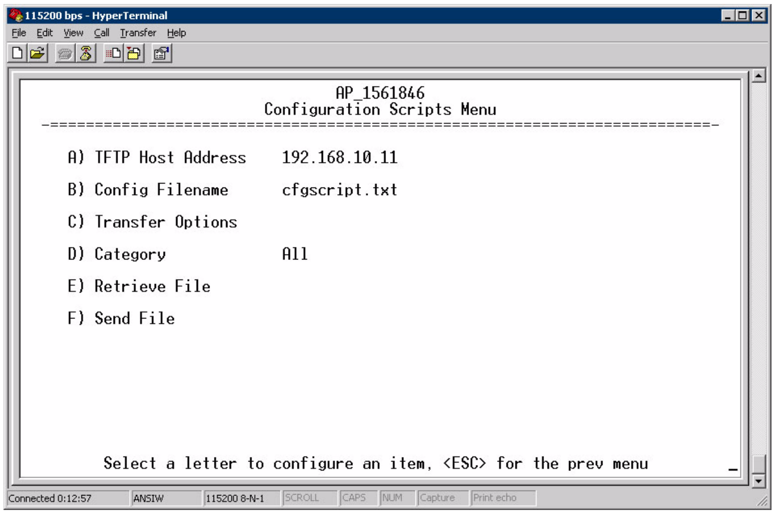
A configuration script file contains all of a radio's setable parameters that are accessible through the menu interface, with a few exceptions. A configuration script file is in plain text format and can be easily edited in any text program.

Configuration scripts can be helpful in several ways. Three common uses for them are:

- To save "known-good" configuration files from your radios. These can be used for later restoration if a configuration problem occurs, and it is unclear what parameter is causing the issue.
- To facilitate the rapid configuration of a large number of radios.
- To provide troubleshooting information when you contact the factory for technical support. A technician can often spot potential problems by reviewing a configuration file.

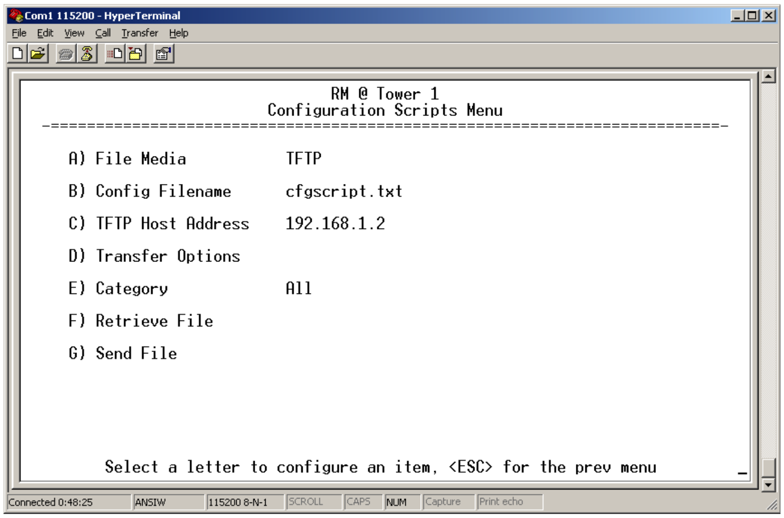
How Configuration Files Work

When a configuration script file is downloaded to a radio (**Retrieve File**), the radio executes the parameters as commands and takes the values contained in it. When a configuration script file is uploaded from the radio (**Send**), it contains the current values of the radio's configuration parameters. Figure 3-111 on Page 134 shows the Configuration Scripts Menu.



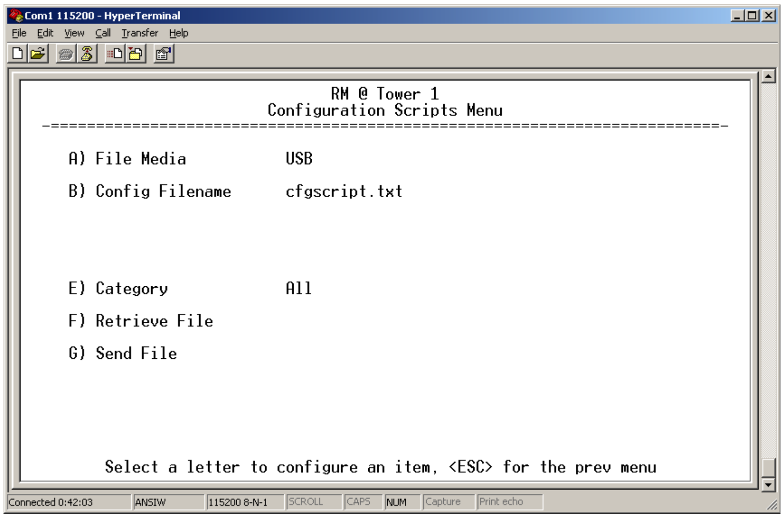
```
                              AP_1561846
                       Configuration Scripts Menu
-===========================================================================-

    A) TFTP Host Address    192.168.10.11

    B) Config Filename      cfgscript.txt

    C) Transfer Options

    D) Category             All

    E) Retrieve File

    F) Send File


         Select a letter to configure an item, <ESC> for the prev menu
```

Figure 3-111. Configuration Scripts Menu



```
                              RM @ Tower 1
                        Configuration Scripts Menu
 -==========================================================================-

    A) File Media           TFTP

    B) Config Filename      cfgscript.txt

    C) TFTP Host Address    192.168.1.2

    D) Transfer Options

    E) Category             All

    F) Retrieve File

    G) Send File



        Select a letter to configure an item, <ESC> for the prev menu
```

Figure 3-112. Configuration Scripts Menu
(Remote with WiFi only)



```
                              RM @ Tower 1
                        Configuration Scripts Menu
 -==========================================================================-

    A) File Media           USB

    B) Config Filename      cfgscript.txt




    E) Category             All

    F) Retrieve File

    G) Send File



        Select a letter to configure an item, <ESC> for the prev menu
```

Figure 3-113. Configuration Scripts Menu
(Remote with WiFi only)

File Media—A selection of methods for transferring files to and from the radio. On firmware version 3.0 radios, the options are **TFTP** and **USB**.

- **Config Filename**—Name of file containing this unit's configuration profile that will be transferred to the TFTP server. The configuration information is in plain-text ASCII format. [**Any 40-character alphanumeric string**] May require a sub-directory, for example: **config\mercury-config.txt**. (See *"Configuration Scripts Menu"* on Page 133 for more information.)

NOTE: The filename field is used to identify the desired incoming file and as the name of the file exported to the TFTP server. Before exporting a unit's configuration, name it in a way that reflects the radio's services or other identification.

- **TFTP Host Address**—IP address of the computer on which the TFTP server resides. [**Any valid IP address**]
- **Transfer Options**—A menu for configuring the TFTP transfer.
- **Category**—The category of parameters to send or receive.
- **Retrieve File**—Initiate the file transfer of the configuration file from TFTP server into the transceiver.
- **Send File**—Initiate the file transfer from the transceiver's current configuration file to TFTP server.

NOTE: See *"Upgrade Procedure"* on Page 132 for details on setting up the TFTP server.

Sample of Configuration Script File

A sample configuration script file is provided as part of every firmware release. Firmware images and sample files are available free-of-charge at: **www.GEmds.com/Resources/TechnicalSupport/**.

The name of the specific file includes the firmware revision number, represented by the "x" characters in the following example: **mercury-config-x_x_x.txt**.

Editing Configuration Files

Once a Remote unit's operation is fine-tuned, use the *Configuration Scripts Menu* on Page 133 to save a copy of the configuration onto a PC. Once the file is saved on the PC, you can use it as a source to generate modified copies adjusted to match other devices. Modify the configuration files using a text editor or an automated process. (These applications are not provided by GE MDS).

We recommend that you review and update the following parameters for each individual unit. Change other parameters as necessary. Save each resulting file with a different name. We recommend using directories and file names that reflect the location of the unit to facilitate later identification.

Table 3-10. Common User-Alterable Parameters

Field	Comment	Range
IP Address	Unique for each individual radio.	Any legal IP address
IP Gateway	May change for different groups or locations.	Any legal IP address

Table 3-10. Common User-Alterable Parameters *(Continued)*

Field	Comment	Range
Device Name	Should reflect a specific device. This information will appear in Management System headings.	Any 20-character alphanumeric string
Location	Used only as reference for network administration.	Any 40-character alphanumeric string

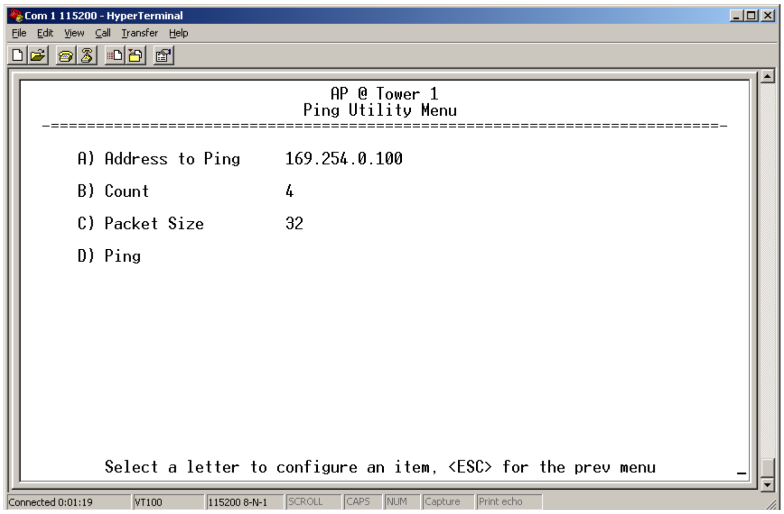
Editing Rules

- Only include parameters you want to change from the default value.
- Change only the parameter values.
- Capitalization counts in some field parameters.
- Comment Fields:
    a. Edit or delete anything on each line to the right of the comment delineator, the semicolon (;).

    b. Comments can be of any length, but must be on the same line as the parameter, or on a new line that begins with a semicolon character.

    c. Comments after parameters in files exported from a transceiver do not need to be present in your customized files.
- Some fields are read-only. These are designated by "(RO)" in the configuration sample file.

Ping Utility Menu



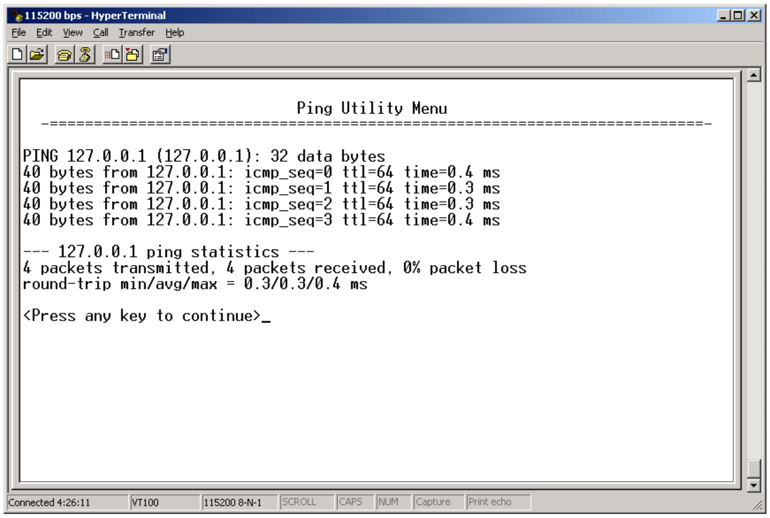
```
                              AP @ Tower 1
                            Ping Utility Menu
-==========================================================================-

     A) Address to Ping      169.254.0.100

     B) Count                4

     C) Packet Size          32

     D) Ping




          Select a letter to configure an item, <ESC> for the prev menu
```

Figure 3-114. Ping Utility Menu

- **Address to Ping**—Address to send a Ping. [**Any valid IP address**]
- **Count**—Number of Ping packets to be sent.
- **Packet Size**—Size of each Ping data packet (bytes).

- **Ping**—Send Ping packets to address shown on screen.

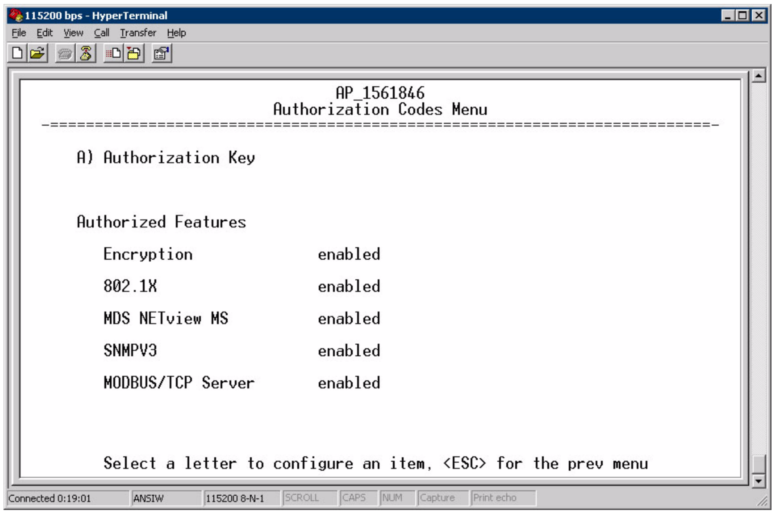
  This screen is replaced with a detailed report of Ping activity (see example in Figure 3-115). Press any key after viewing the results to return to this menu.



```
                          Ping Utility Menu
  -========================================================================-

PING 127.0.0.1 (127.0.0.1): 32 data bytes
40 bytes from 127.0.0.1: icmp_seq=0 ttl=64 time=0.4 ms
40 bytes from 127.0.0.1: icmp_seq=1 ttl=64 time=0.3 ms
40 bytes from 127.0.0.1: icmp_seq=2 ttl=64 time=0.3 ms
40 bytes from 127.0.0.1: icmp_seq=3 ttl=64 time=0.4 ms

--- 127.0.0.1 ping statistics ---
4 packets transmitted, 4 packets received, 0% packet loss
round-trip min/avg/max = 0.3/0.3/0.4 ms

<Press any key to continue>_
```

Figure 3-115. Ping Results Screen

Authorization Codes



```
                             AP_1561846
                       Authorization Codes Menu
  -=========================================================================-

      A) Authorization Key


      Authorized Features

         Encryption                enabled

         802.1X                    enabled

         MDS NETview MS            enabled

         SNMPV3                    enabled

         MODBUS/TCP Server         enabled



         Select a letter to configure an item, <ESC> for the prev menu
```

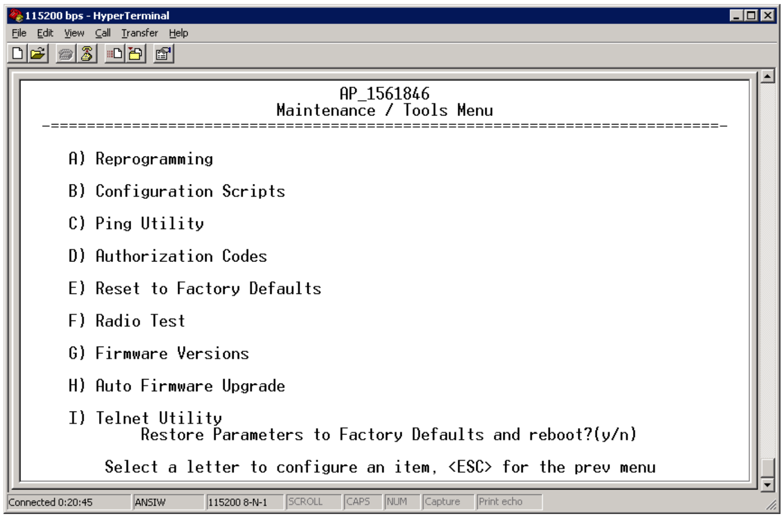
Figure 3-116. Authorization Codes Menu

- **Authorization Key**—For entering an Authorization Key into the transceiver’s non-volatile memory.
- **Authorized Features**—List of the transceiver’s authorized features. Each item shows **enabled** or **disabled** according to the settings allowed by the Authorization Key entered into the radio.

Reset to Factory Defaults

Use the **Reset to Factory Defaults** selection on the Maintenance/Tools Menu to return all configurable settings to those set at the factory prior to shipping. Use this selection with caution, as you will lose any custom settings you have established for your transceiver, and will need to re-enter them using the menu system.

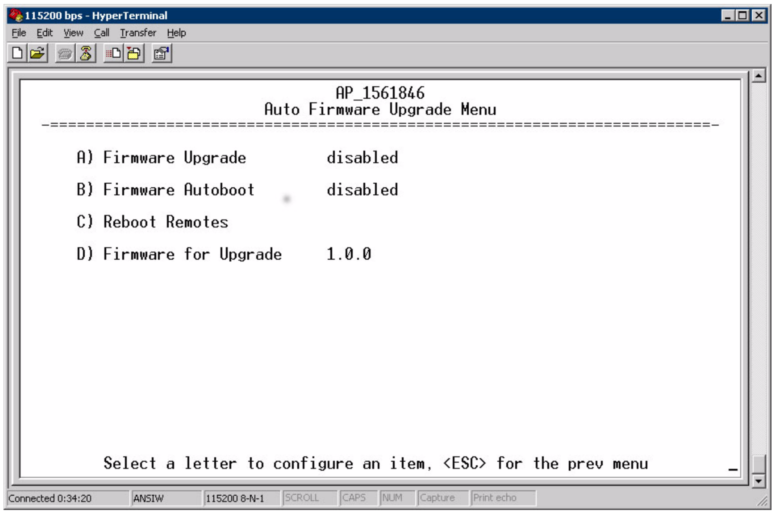
To prevent accidental use of the command, a “challenge” question is presented at the bottom of the screen when this choice is selected (see Figure 3-117 on Page 139). To proceed, enter **y** for yes or **n** for no, and then press Enter. (You may also press the Escape key on your keyboard to exit this command without making any changes.)



```
                                   AP_1561846
                            Maintenance / Tools Menu
 -==========================================================================-

     A) Reprogramming

     B) Configuration Scripts

     C) Ping Utility

     D) Authorization Codes

     E) Reset to Factory Defaults

     F) Radio Test

     G) Firmware Versions

     H) Auto Firmware Upgrade

     I) Telnet Utility
          Restore Parameters to Factory Defaults and reboot?(y/n)

        Select a letter to configure an item, <ESC> for the prev menu
```

Figure 3-117. Reset to Factory Defaults Action
(Note challenge question at bottom of screen)

3.12.2 Auto Firmware Upgrade Menu (AP Only)



```
                         AP_1561846
                  Auto Firmware Upgrade Menu
 -==========================================================================-

     A) Firmware Upgrade         disabled

     B) Firmware Autoboot        disabled

     C) Reboot Remotes

     D) Firmware for Upgrade     1.0.0



        Select a letter to configure an item, <ESC> for the prev menu
```

Figure 3-118.Auto Firmware Upgrade Menu

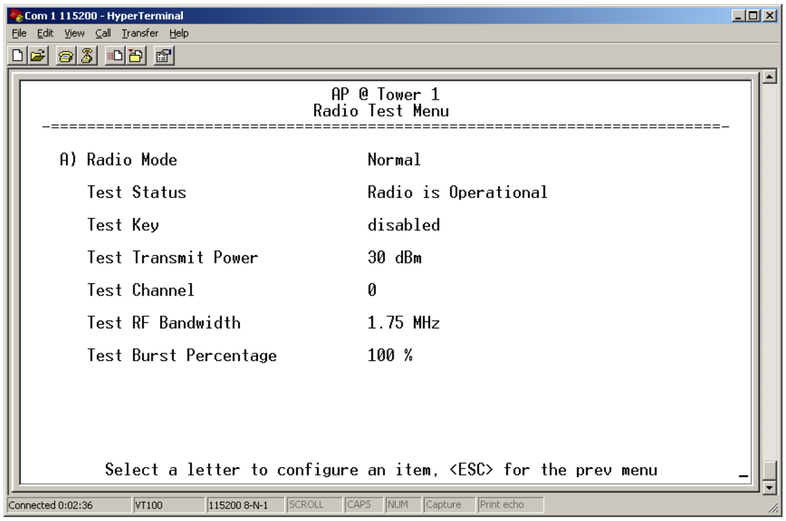
- **Firmware Upgrade**—Causes all of the Remotes associated to this AP to read the AP's specified (by **Firmware for Upgrade**) firmware version (active or inactive), and download it via TFTP to the inactive image if the Remote does not already have that firmware version.
- **Firmware Autoboot**—Boot connected remotes to **Firmware for Upgrade** (see below).
- **Reboot Remotes**—Determines how a Remote behaves once it has downloaded new firmware from the AP as part of an auto-upgrade. When enabled, the Remotes reboot to the new firmware.

NOTE: To use the Auto Upgrade/Reboot feature, both the AP and Remotes must already be running version 2.1.0 or newer firmware.

- **Firmware for Upgrade**—Specifies the firmware version that the Remotes should download, if they do not already have it.

Radio Test Menu

Using this menu, you can manually key the radio transmitter for performance checks and set several parameters that will be used when the Radio Mode is set to **Test**.



```
                              AP @ Tower 1
                            Radio Test Menu
-========================================================================-

   A) Radio Mode                      Normal

      Test Status                     Radio is Operational

      Test Key                        disabled

      Test Transmit Power             30 dBm

      Test Channel                    0

      Test RF Bandwidth               1.75 MHz

      Test Burst Percentage           100 %




        Select a letter to configure an item, <ESC> for the prev menu
```

Figure 3-119. Radio Test Menu

NOTE : Using Test Mode disrupts traffic through the radio. If the unit is an Access Point, it will disrupt traffic through the *entire* network. The Test Mode function is automatically limited to 10 minutes. *Only use Test Mode for brief measurements*.

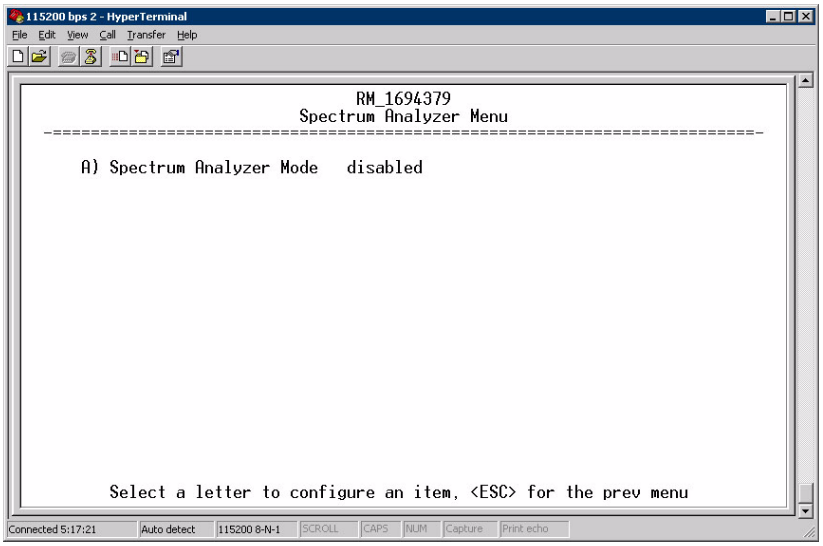
- **Radio Mode**—Sets/displays the radio's operating mode. To change the setting, press **A** on the PC's keyboard and press the Spacebar to toggle between the two settings. Press the Enter key to select the desired state. [**Normal, Test; Normal**]
- **Test Status**—This read-only parameter shows the current state of the radio.
  [**Radio is Operational, Reconfiguring the Radio, Ready to KEY**]

The following parameters are read-only unless **A) Radio Mode** is first selected and set to **Test**. In Test Mode, these items become selectable, and you can set their entries using the Spacebar or with a numeric entry, followed by pressing the Enter key.

- **Test Key**—Sets/displays keying status of the radio's transmitter. Use the Spacebar to view selections. [**disabled, enabled; disabled**]
- **Test Transmit Power**—Sets/displays the transmitter's power setting. Make a numerical entry within the allowable range.
  [3650 model: **+23 dBm max**]
  [900 model: **-30 to +29 dBm**]
- **Test Channel**—Sets/displays the radio's test channel number. Make a numerical entry within the allowable range.
  [**0-13; 0**]
- **Test RF Bandwidth**—Sets/displays the transmitter's bandwidth for testing. Use the Spacebar to view selections.
  [**1.75. 3.5 MHz; 1.75 MHz**—additional selections for 3650 model]
- **Test Burst Percentage**—Sets/displays the percentage of Burst size to use for testing. Make a numerical entry within the allowable range. [**0-100%; 100**]

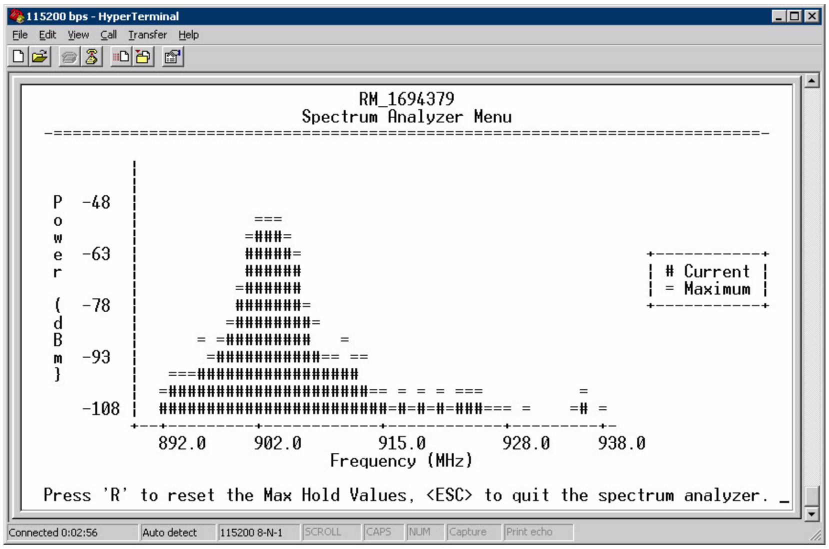
Spectrum Analyzer Menu (Remote Only)

Using this menu, you can enable or disable the remote's spectrum analyzer mode (Figure 3-120 on Page 142). When enabled, the remote displays through the terminal a spectrum analyzer view of the current activity that its receiver can see. The view shows power vs. frequency (see Figure 3-121 on Page 142).



```
                                  RM_1694379
                            Spectrum Analyzer Menu
 -===========================================================================-

     A) Spectrum Analyzer Mode   disabled











        Select a letter to configure an item, <ESC> for the prev menu
```

Figure 3-120. Spectrum Analyzer Menu



```
                                  RM_1694379
                            Spectrum Analyzer Menu
-===========================================================================-

         |
 P  -48  |
 o       |            ===
 w       |           =###=
 e  -63  |           #####=                                     +-----------+
 r       |           ######                                     | # Current |
         |          =######                                     | = Maximum |
 (  -78  |          #######=                                    +-----------+
 d       |         =########=
 B       |      = =#########    =
 m  -93  |       =###########==  ==
 }       |   ===##################
         |  =######################== = = = ===          =
    -108 |  #########################=#=#=#=###=== =    =# =
         +--+---------+-------------+------------+---------+-
            892.0     902.0         915.0        928.0     938.0
                              Frequency (MHz)

Press 'R' to reset the Max Hold Values, <ESC> to quit the spectrum analyzer.
```

Figure 3-121. Spectrum Analyzer Display

3.13 PERFORMANCE OPTIMIZATION

After checking basic radio operation, you can optimize the network's performance. The effectiveness of these techniques varies with the design of your system and the format of the data being sent.

There are two major areas for possible improvement—the radio and the data network. These sections provide a variety of items to check in both categories, and in many cases, ways to improve performance.

NOTE: Antennas are one of the most important portions of the wireless system. A properly installed antenna with an unobstructed path to associated stations is the optimal configuration, and should be among the first items checked when searching for performance gains.

Stronger signals allow the use of wider bandwidths and higher data speeds with fewer retries of data transmissions. Time spent optimizing the antenna systems on both AP and Remote stations will often have a huge benefit to system performance. Refer to *INSTALLATION PLANNING* on Page 165 for additional recommendations on antenna systems.

Table 3-11 on Page 144 provides suggested settings for typical installation scenarios. These settings provide a starting point for configuration of AP and Remote units. Changes might be required to achieve the desired results in a particular situation.

Table 3-11. Recommended Settings for Common Scenarios

For Fixed Locations, where best combination of range and throughput is desired.						
			AP	**Remote**	**Units**	**Notes**
Radio Configuration		**Network Name**	User discretion	User discretion		AP and Remote must match.
		Transmit Power (AP)/ Max Transmit Power (RM)	30 (3650 model: 23)	30 (3650 model: 23)	dBm	In most cases, power can be set to this level and left alone. Setting it lower helps control cell overlap.
		Receive Power	-70	N/A	dBm	Sets AP receiver for medium gain. Typical range: -60, -80 dBm.
	Frequency Control	**Frequency Mode**	Static Hopping	Static Hopping		
		Frame Duration	20	20	ms	Changing to 10 ms lowers latency. 5 and 8 ms selections not functional for this release.
		Hop Pattern	A, B, C, D	A, B, C, D		AP and RM must match.
		Hop Pattern Offset	0-13 or 0-6	0-13 or 0-6		AP and RM must match.
		Channel Selection	User discretion	User discretion		Disable channels with interference. AP and RM must match.
		TDD Sync Mode	GPS Required	N/A		GPS Antennas must be connected to both AP and RM.
	Advanced Configuration	**Adaptive Modulation**	Enabled	Enabled		
		Protection Margin	3	3	dB	
		Hysteresis Margin	3	3	dB	
		Data Compression	Enabled	Enabled		Gives best throughput numbers, but may hide true performance if only tested with PING or Text File FTP.
		Max Modulation	QAM/16-3-4	QAM16-3/4		Best combination of range and throughput.
		Cyclic Prefix	1/16	N/A		Best throughput setting.
		Channel Type	Static	N/A		Less periodic ranging when channel type is Static.
		ARQ	Enabled	N/A		
		ARQ Block Size	256	N/A	bytes	
		ARQ Block Lifetime	655	N/A	ms	These 3 settings make the max. no. of ARQ retries =9. (655 ms)/(35 ms + 35 ms = 9.35=>9
		ARQ TX Delay	35	N/A	ms	
		ARQ RX Delay	35	N/A	ms	
		Adaptive Split	Enabled	N/A		Maximizes one-way burst throughput.
		Downlink%	50	N/A	%	If Adaptive Split is disabled, can set downlink% to 15%–75%.

For Optimal Sensitivity
(Trades off throughput for best possible sensitivity. AP more susceptible to interference)

		AP	Remote	Units	Notes
Radio Configuration	**Receive Power**	-80	N/A	dBm	Sets AP receiver for highest gain.

When Heavy Interference Exists at AP
(Trades off range for robustness in the face of interference)

		AP	Remote	Units	Notes
Radio Configuration	**Receive Power**	-60	N/A	dBm	Sets AP receiver for low gain, which forces Remote transmit power to be high.

For Mobile Systems
(Where hand-offs between APs are required)

			AP	Remote	Units	Notes
Radio Configuration	**Frequency Control**	**Frequency Mode**	Static Hopping	Hopping w/Hand-offs		
	Advanced Configuration	**Protection Margin**	6	6	dB	More channel variation in mobile, so use more robust modulation with greater SNRs.
		Channel Type	Dynamic	N/A		Less periodic ranging when Channel Type = Static.
Network Configuration	**AP Location Info Config**	**Retrieve Text File**	N/A	AP Locations file		AP locations file with coordinates and key attributes of APs to which Remote can associate.

3.13.1 Recommended Settings for Common Scenarios

Table 3-12 and Table 3-13 on Page 146 show target performance values for AP and Remote transceivers. View these values using the built-in menu system by navigating the path shown under each table title.

Table 3-12. Mercury Remote Transceiver
(Performance Information>>Internal Radio Status Menu)

Name	Target Value	Notes
Connection Status	Associated	Remote must be associated for network operation.
Transmit Power	Varies	Adjusts automatically as requested by AP.
RSSI (Received Signal Strength Indication)	Varies	The less negative an RSSI reading, the stronger the signal (i.e., -75 dBm is stronger than -85 dBm).

Table 3-12. Mercury Remote Transceiver *(Continued)*
(Performance Information>>Internal Radio Status Menu)

Name	Target Value	Notes
SNR (Signal-to-Noise Ratio)	Strong signal (bench setting): 25-28 dB Operational: 3-30 dB Typ. System: 10-20 dB	A low SNR may be caused by noise or interfering signals.
TX Freq. Offset	0-22,875 Hz	Adjusts to accommodate what is expected by the AP.
RX Freq. Offset	0-22,875 Hz	Adjusts to accommodate what is expected by the AP.
Total FEC Count	Varies	
Corrected FEC Count	Varies	
Uncorrected FEC Count	Varies	
Current AP Name	Device name of associated AP	Typically set to reflect the application or system the radio is used in.

Table 3-13. Mercury Access Point
(Performance Information>>Wireless Network Status>> Remote Performance Database)

Name	Target Value	Notes
MAC ADDR	MAC Address of associated Remote	Must match Remote’s MAC address exactly
RSSI (Received Signal Strength Indication)	Varies	The less negative an RSSI reading, the stronger the signal (i.e., -75 dBm is stronger than -85 dBm).
SNR Signal-to-Noise Ratio	Strong signal (bench): 25-28 dB Operational: 3-30 dB Typ. System:10-20 dB	A low SNR may be caused by noise or interfering signals.
Downlink	Varies	QPSK/FEC-3/4 Preferred
Uplink	Varies	QPSK/FEC-3/4 Preferred
FEC Total	Varies	
Corrected FEC Count	Varies	
Uncorrected FEC Count	Varies	

Additional Considerations for Mobile Operation

Consider the following key points for all mobile installations:

NOTE: 3650 MHz is for APs and Fixed Remote stations only.

- Use connectionware—The use of connectionware in the mobile laptops is highly recommended for better operation of a mobile data system. GE MDS provides connectionware from one of the vendors in this market. Contact your factory representative for details.
- Plan your network coverage—Deploy Access Points so that they provide overlapping coverage with each other. Access Points must use the same Network Name to enable roaming service.
- Set the RSSI Threshold to -70 dBm—This level is typically used for mobile systems with good performance. Make sure there is overlapping coverage of more than one AP to provide continuous coverage.
- At every AP Radio, review the following settings when providing service to mobile remotes:
  - **TDD Sync**—Set to **GPS Required**.
  - **Pattern Offset**—Each AP should be different. Cell planning is required if there are overlaps.
  - **Hop Pattern**—Set the same on all APs.
  - **Compression** [**disabled**]—Disable radio compression. Data compression is best performed by the connectionware running on the mobile laptop PC. Gains in efficiency are made because connectionware compresses data at a higher stack level, and it aggregates multiple data frames and streams into a single packet. Compression at the radio level, although highly efficient, works only at the individual packet level.

4 TROUBLESHOOTING & RADIO MEASUREMENTS

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Digital Energy
MDS

4.1 TROUBLESHOOTING

Successful troubleshooting of a wireless system is not difficult, but requires a logical approach. It is best to begin troubleshooting at the Access Point unit, as the rest of the system depends on the Access Point for synchronization data. If the Access Point has problems, the operation of the entire wireless network is affected.

When you find communication problems, it is good practice to begin by checking the simple causes. Applying basic troubleshooting techniques in a logical progression identifies many problems.

Multiple Communication Layers

It is important to remember that the operation of the network is built on a radio communications link. On top of that are two data levels— wireless MAC, and the data layer. It is essential that the wireless aspect of the Access Point and the Remotes units to be associated operates properly before data-layer traffic will function.

Unit Configuration

There are numerous user-configurable parameters in the Management System. Do not overlook the possibility that human error is the cause of the problem. With so many parameters to view and change, a parameter might be incorrectly set, and then that change is forgotten.

To help avoid these problems, GE MDS recommends creating an archive of the transceiver’s profile in a Configuration File when your installation is complete. You can reload this file into the transceiver to restore the unit to the factory defaults or your unique profile. For details on creating and archiving Configuration Files, see *“Configuration Scripts Menu”* on Page 133.

NOTE: The radio’s menu settings may be tailored to optimize performance in specific application scenarios. For recommended in-service settings, refer to *PERFORMANCE OPTIMIZATION* on Page 142.

Factory Assistance

If problems cannot be resolved using the guidance provided here, review the GE MDS web site’s technical support area for recent software/firmware updates, general troubleshooting help, and service information. Additional help is available through our Technical Support Department. (See “TECHNICAL ASSISTANCE” on the inside of the rear cover.)

4.1.1 Interpreting the Front Panel LEDs

An important set of troubleshooting tools are the LED status indicators on the front panel of the radio case. You should check them first whenever a problem is suspected. Table 2-2 on Page 30 describes the function of each status LED. Table 4-1 on Page 152 provides suggestions for resolving common system difficulties using the LEDs, and Table 4-2 on Page 153 provides other simple techniques.

Table 4-1. Troubleshooting Using LEDs—Symptom-Based

Symptom	Problem/Recommended System Checks
PWR LED does not turn on	a. Voltage too low—Check for the proper supply voltage at the power connector. (10–30 Vdc) b. Indefinite Problem—Cycle the power and wait (≈ 30 seconds) for the unit to reboot. Then, recheck for normal operation.
LINK LED does not turn on	a. Network Name of Remote not identical to desired Access Point—Verify that the system has a unique Network Name. b. Not yet associated with an Access Point with the same Network Name. Check the "Status" of the unit's process of associating with the Access Point. Use the Management System. c. Poor Antenna System—Check the antenna, feedline and connectors. Reflected power should be less than 10% of the forward power reading (SWR 2:1 or lower).
PWR LED is blinking	a. Blinking indicates that an alarm condition exists. b. View Current Alarms and Event Log and correct the problem if possible. (See *"Using Logged Operation Events"* on Page 155) c. Blinking continues until the source of the alarm is corrected, for example, a valid IP address is entered, etc.
LAN LED does not turn on	a. Verify the Ethernet cable is connect at both ends. b. Verify that the appropriate type of Ethernet cable is used: straight-through or crossover.
LAN LED lights, but turns off after some time	Verify traffic in LAN. Typically, the radio should not be placed in high traffic enterprise LANs, as it will not pass this level of traffic. If needed, use routers to filter traffic.
GPS LED not lit	No satellite fix has been obtained. A fix is required for all operation except single-frequency channel (non-hopping) configurations. The lack of a fix may be caused by an obstructed "view" of the satellites, or a GPS antenna problem. The GPS LED blinks slowly on the AP while it synchronizes its internal clock to the GPS signal. When in this condition, the AP does not transmit.

4.1.2 Troubleshooting With the Embedded Management System

If you have reviewed and tried the items listed in Table 4-1 and still have not resolved the problem, there are additional tools and techniques you can use. The embedded Management System is a good source of information that you can use remotely to provide preliminary diagnostic information, or may even provide a path to correcting the problem. Refer to Table 4-2 on Page 153 for more information on using the Management System as a troubleshooting tool.

Table 4-2. Basic Troubleshooting Using the Management System

Symptom	Problem/Recommended System Checks
Cannot access the MS through COM1	a. Connect to unit via Telnet or Web browser. b. Disable the serial mode for COM1 (Serial Gateway Configuration>>Com1 Serial Data Port>>Status>>Disabled). Or, if you know the unit's data configuration: a. Connect to COM 1 via a terminal set to VT100 and the port's data baud rate. b. Type **+++**. c. Change the terminal's baud rate to match the transceiver's Console Baud Rate. d. Type **+++**.
Display on terminal/Telnet screen garbled	Verify the terminal/terminal emulator or Telnet application is set to VT100.
Password forgotten	a. Connect to the transceiver using a terminal through the COM1 Port. b. Obtain a password-resetting Authorization Key from your factory representative. c. At the login prompt, try the user name *authcode*, and enter the Authorization Key for the password.
Remote only gets to **Connecting**	a. Check Network Name, encryption, and Device Auth Mode settings. b. Verify that the correct MAC address is listed in the Approved Remotes List of the Security Configuration Menu.
Remote only gets to **Authenticating**	Check encryption settings and security mode settings.
Cannot pass IP data to WAN	a. Verify your IP settings. b. Use the PING command to test communication with the transceivers in the local radio system. c. If successful with local PING, attempt to PING an IP unit attached to a transceiver. d. If successful with the LAN PINGs, try connecting to a known good unit in the WAN.
Wireless Retries too high	Possible Radio Frequency Interference: a. If omnidirectional antennas are used, consider changing to directional antennas. This usually limits interference to and from other stations. b. Try disabling channels where persistent interference is known or suspected. c. The installation of a filter in the antenna feedline may be necessary. Consult the factory for further assistance. d. Try using an antenna with a downward tilt.

The following is a summary of how you can use several screens in the Management System as diagnostic tools. For information on how to connect to the Management System, see *“STEP 3: CONNECT PC TO THE TRANSCEIVER”* on Page 25.

Starting Information Screen

(See *Starting Information Screen* on Page 42)

The Management System’s home page provides some valuable bits of data. One of the most important is the **Device Status** field. This item tells you if the unit is operational.

If the **Device Status** field says **Associated**, then look in the network areas beginning with network data statistics. If it displays some other message, such as **Scanning**, **Connecting**, or **Alarmed**, you must determine why it is in this state.

The *Scanning* state indicates a Remote unit is looking for an Access Point beacon signal to lock onto. It should move to the *Connecting* state and finally to the *Associated* state within less than a minute. If this Remote unit is not providing reliable service, look at the *Event Logs* for signs of lost association with the Access Point, or low signal alarms. Table 4-3 provides a description of the Device Status messages.

Table 4-3. Device Status[1]

Scanning	The unit is looking for an Access Point beacon signal.
Ranging	Remote has detected AP and is synchronizing to it.
Connecting	The Remote has established a radio (RF) connection with the Access Point and is negotiating the network layer connectivity.
Authenticating[2]	The Remote is authenticating itself to the network to obtain cyber-security clearance in order to pass data.
Associated	This unit has successfully synchronized and is “associated” with an Access Point. This is the normal operating state.
Alarmed	The unit has detected one or more alarms that have not been cleared.

[1] Device Status is available in the *Startup Information Screen* or the *Wireless Status Screen* at Remotes.

[2] If Device Authentication is enabled.

If the Remote is in an *Alarmed* state, the unit might still be operational and associated. Look for the association state in the *Wireless Network Status* screen to determine if the unit is associated. If it is, look at the *Error Log* for possible clues.

If the unit is in an *Alarmed* state and is not associated with an Access Point, then there might be a problem with the wireless network layer. Call a radio technician to deal with wireless issues. Refer the technician to the *RADIO (RF) MEASUREMENTS* on Page 159 for information on antenna system checks.

Packet Statistics Menu

(See Packet Statistics Menu on Page 116)

This screen provides detailed information on data exchanges between the unit being viewed and the network through the wireless and the Ethernet (data) layers. These include:

Wireless Packet Statistics

- Packets received
- Packets sent
- Bytes received
- Bytes sent
- Packets dropped
- Receive errors
- Retries
- Retry errors

Ethernet Packet Statistics

- Packets received
- Packets sent
- Bytes received
- Bytes sent
- Lost carrier detected
- Packets dropped
- Receive errors
- Retries
- Retry errors

The most significant fields are the *Packets Dropped*, *Retries*, *Retry Errors*, *Receive Errors* and *Lost Carrier Detected*. If the data values are more than 10% of their sent and received counterparts, or the *Lost Carrier Detected* value is greater than a few dozen, there might be trouble with radio-frequency interference or a radio link of marginal strength.

If errors are excessive, check the aiming of the antenna system, and check for a satisfactory SWR. Refer to *RADIO (RF) MEASUREMENTS* on Page 159 for information on antenna system checks.

Diagnostic Tools

(See MAINTENANCE/TOOLS MENU on Page 125)

The radio's Maintenance menu contains two tools that are especially useful to network technicians—the *Radio Test Menu* and the *Ping Utility*. Use the Radio Test selection for testing RF operation. Use the Ping Utility to verify communications access to pieces of equipment connected to the radio network. This includes transceivers and user-supplied Ethernet devices.

4.1.3 Using Logged Operation Events

(See PERFORMANCE INFORMATION MENU on Page 112)

The transceiver's microprocessor monitors many operational parameters and logs them as various classes of *events*. If the event is one that affects performance, it is an *alarm*. There are also normal or routine events such as those marking the rebooting of the system, implementation of parameter changes, and external access to the Management System. Informational events are stored in temporary (RAM) memory that is lost in the absence of primary power, and Alarms are stored in permanent memory (Flash memory) until cleared by user request. Table 4-4 summarizes these classifications.

Table 4-4. Event Classifications

Level	Description/Impact	Storage
Alarms	Transceiver has detected one or more alarm conditions	Flash Memory
Informational	Normal operating activities	Flash Memory
Temporary Informational	Transient conditions or events	RAM
Minor	Does not affect unit operation	RAM
Major	Degraded unit performance but still capable of operation	RAM
Critical	Prevents the unit from operating	RAM

These events are stored in the transceiver's *Event Log* and can be a valuable aid in troubleshooting unit problems or detecting attempts at breaching network security.

4.1.4 Alarm Conditions

Most events, classified as "critical" will cause the PWR LED to blink, and will inhibit normal operation of the transceiver. The LED blinks until the corrective action is completed. (See also *Event Log Menu* on Page 115.)

Table 4-5. Alarm Conditions (Alphabetical Order)

Alarm Condition Reported	Event Log Entry	SNMP Trap
EVENT_BRIDGE	Network Interface /Error	networkInterface(17)
EVENT_FREQ_CAL	Frequency Not Calibrated	frequencyCal(7)
EVENT_INIT_ERR	Initialization Error	initializationError(18)
EVENT_IPADDR*	IP Address Invalid	ipAddressNotSet(4)
EVENT_IPMASK*	IP Mask Invalid	ipNetmaskNotSet(5)
EVENT_LAN_PORT		lanPortStatus(78)
EVENT_MAC	MAC communication Failed	macCommunication(1)
EVENT_MACADDR	MAC Address Invalid	noMacAddress(6)
EVENT_NETNAME*	Netname Invalid	invalidNetname(12)
EVENT_POWER_CAL	Power Calibrated/Not Calibrated	powerCal(8)
EVENT_REMOTE	Remote Added/ Removed (AP Only)	eventRemote(66)
EVENT_RSSI*	RSSI Exceeds threshold	rssi(11)

Table 4-5. Alarm Conditions (Alphabetical Order) ***(Continued)***

Alarm Condition Reported	Event Log Entry	SNMP Trap
EVENT_RSSI_CAL	RSSI Not Calibrated	rssiCal(9)
EVENT_SYSTEM_ERROR*	System Error Cleared; Please Reboot	systemError(16)
EVENT_TFTP_CONN	TFTP connectivity achieved	tftpConnection(73)
EVENT_TFTP_ERR	Attempted TFTP connection failed	tftpConnFailed(79)

* User can correct condition, clearing the alarm.

4.1.5 Correcting Alarm Conditions

(See Event Log Menu on Page 115)

Table 4-6 provides likely causes of events that inhibit the unit from operating, and possible corrective actions. The Event Description column appears on the **Event Log** screen.

Table 4-6. Correcting Alarm Conditions—Alphabetical Order

Event Log Entry	Generating Condition	Clearing Condition or Action
Bridge Down	The Bridge fails to be initialized.	Contact factory Technical Services for assistance.
General System Error	Internal checks suggest unit is not functioning properly.	Reboot the transceiver.
Initialization Error	Unit fails to complete boot cycle.	Contact factory Technical Services for assistance.
Invalid IP Address	The IP address is either 0.0.0.0 or 127.0.0.1.	Program IP address to something other than 0.0.0.0 or 127.0.0.1.
Network Interface Error	Unit does not recognize the LAN interface.	Contact factory Technical Services for assistance.
RSSI Exceeds Threshold	The running-average RSSI level is weaker (more negative) than the user-defined value.	Check the aiming of the directional antenna at the Remote; raise the threshold level to a stronger (less-negative) value.

4.1.6 Logged Events

The following events allow the transceiver to continue operation and do not make the PWR LED blink. Each is reported through an SNMP trap.

The left hand column, *Event Log Entry*, is what shows in the Event Log. (See also *Event Log Menu* on Page 115.)

Table 4-7. Non-Critical Events—Alphabetical Order

Event Log Entry	Severity	Description
Association Attempt Success/Failed	MAJOR	Self explanatory
Association Lost - Local IP Address Changed	MAJOR	Self explanatory
Association Lost - Local Network Name Changed	MAJOR	Self explanatory
Association Lost/Established	MAJOR	Self explanatory
Auth Demo Mode Expired -- Rebooted Radio/Enabled	MAJOR	Self explanatory
Auth Key Entered - Key Valid/Key Invalid	MAJOR	Self explanatory
Console Access Locked for 5 Min	MAJOR	Self explanatory
Console User Logged Out/Logged In	MAJOR	Self explanatory
Current AP No Longer Approved	MAJOR	May occur during the Scanning process at a Remote. Indicates that the received beacon came from an AP which is not in the “Approved AP” list. This might be caused by some Remotes hearing multiple AP's. This event is expected behavior.
Decryption Error/Decryption OK	MAJOR	A decryption error is logged when an encryption phrase mismatch has occurred. A mismatch is declared after five consecutive errors over a 40-second window. When the error has cleared, **DECRYPT OK** appears.
Ethernet Port Enabled/Disabled	INFORM	Self explanatory
Ranging Lost/Established	INFORM	Self explanatory
Connecting Lost/Established	INFORM	Self explanatory
HTTP Access Locked for 5 Min	MAJOR	Self explanatory
HTTP User Logged Out/Logged In	MAJOR	httpLogin(49)
Log Cleared	INFORM	Self explanatory
Reprogramming Complete	INFORM	Self explanatory
Reprogramming Failed	MAJOR	Self explanatory
Reprogramming Started	INFORM	Self explanatory
Scanning Started	INFORM	Self explanatory
SNR Within threshold/Below threshold	INFORM	Self explanatory

Table 4-7. Non-Critical Events—Alphabetical Order *(Continued)*

Event Log Entry	Severity	Description
System Bootup (power on)	INFORM	Self explanatory
Telnet Access Locked for 5 Min	MAJOR	Self explanatory
Telnet User Logged Out/Logged In	MAJOR	Self explanatory
User Selected Reboot	MAJOR	Self explanatory

4.2 RADIO (RF) MEASUREMENTS

There are several measurements that should be performed during the initial installation. These measurements confirm proper operation of the unit and, if they are recorded, serve as a benchmark in troubleshooting should difficulties appear in the future. These measurements are:

- Transmitter Power Output
- Antenna System SWR (Standing-Wave Ratio)
- Antenna Direction Optimization

These procedures might interrupt traffic through an established network and should only be performed by a skilled radio-technician in cooperation with the Network Administrator.

4.2.1 Antenna System SWR and Transmitter Power Output

Introduction

A proper impedance match between the transceiver and the antenna system is important. It ensures the maximum signal transfer between the radio and antenna. You can check the impedance match indirectly by measuring the SWR (standing-wave ratio) of the antenna system. If the results are normal, record them for comparison during future routine preventive maintenance. Abnormal readings indicate possible trouble with the antenna or the transmission line, and should be corrected.

Check the SWR of the antenna system before putting the radio into regular service. For accurate readings, a wattmeter suited to the frequency of operation is required. One unit meeting this criteria is the Bird Model 43™ directional wattmeter with the appropriate element installed.

The reflected power should be less than 10% of the forward power (≈2:1 SWR). Higher readings indicate problems with the antenna, feedline or coaxial connectors.

Record the current transmitter power output level, then set it to an adequate signal level for the directional wattmeter (for the duration of the test.)

Procedure

1. Place a directional wattmeter between the TX antenna connector and the antenna system.

2. Place the transceiver into the Radio Test Mode using the menu sequence below:
   (Maintenance/Tools Menu>>Radio Test>>Radio Mode>>Test)

3. Set the transmit power to 29 dBm (900 model), or 23 dBm (3650 model). (This setting does not affect the output level during normal operation—only during Test Mode.)
   (Maintenance/Tools Menu>>Radio Test >>Test Mode>>Test>>Test Transmit Power)

4. Key the transmitter.
   (Maintenance/Tools Menu>>Radio Test>>Test Mode>>Test>>Test Key>> enabled)

   Use the PC's spacebar to key and unkey the transmitter. (Enable/Disable)

NOTE: The Transmit Key has a 10-minute timer, after which it unkeys the radio. Manually unkey the transmitter by selecting **Test Key>>disabled** on the menu, or temporarily disconnecting the radio's DC power.

5. Measure the forward and reflected power into the antenna system and calculate the SWR and power output level. The output should agree with the programmed value set in the Radio Configuration Menu. **(Radio Configuration>>Transmit Power)**

6. Turn off Radio Test Mode.
   (Maintenance/Tools Menu>>Radio Test>>Test Key>>disabled)

End of procedure.

4.2.2 Antenna Aiming (For Directional Antennas)

Introduction

The radio network integrity depends, in a large part, on stable radio signal levels at each end of a data link. In general, signal levels stronger than –80 dBm provide the basis for reliable communication that includes a 15 dB fade margin. As the distance between the Access Point and Remotes increases, the influence of terrain, foliage, and man-made obstructions become more influential, and the use of directional antennas at Remote locations becomes necessary. Directional antennas require fine-tuning of their bearing to optimize the received signal strength. The transceiver has a built-in received signal strength indicator (RSSI) that can tell you when the antenna is in a position that provides the optimum received signal.

RSSI measurements and Wireless Packet Statistics are based on multiple samples over a period of several seconds. The average of these measurements is displayed by the Management System.

The measurement and antenna alignment process usually takes 10 or more minutes at each radio unit.

The path to the Management System menu item is shown in bold text below each step of the procedure.

Procedure

1. Verify the Remote transceiver is associated with an Access Point unit by observing the condition of the LINK LED (**LINK LED = On** or **Blinking**). This indicates that you have an adequate signal level for the measurements and it is safe to proceed.

2. Record the *Wireless Packets Dropped* and *Received Error* rates.
   (Main Menu>>Performance Information>>Packet Statistics>>Wireless Packet Statistics)

   This information will be used later.

3. Clear the *Wireless Packets Statistics* history.

   (Main Menu>>Performance Information>>Packet Statistics>>Wireless Packet Statistics>>Clear Wireless Stats)

4. Read the RSSI level at the Remote.
   (Main Menu>>Performance Information>>Internal Radio Status)

5. Optimize RSSI (less negative is better) by slowly adjusting the direction of the antenna.

   Watch the RSSI indication for several seconds after making each adjustment so that the RSSI accurately reflects any change in the link signal strength.

6. View the *Wireless Packets Dropped* and *Received Error* rates at the point of maximum RSSI level. They should be the same or lower than the previous reading.

   (Main Menu>>Performance Information>>Packet Statistics>>Wireless Packet Statistics)

7. If the RSSI peak results in an increase in the *Wireless Packets Dropped* and *Received Error*, the antenna may be aimed at an undesired signal source. Try a different antenna orientation.

End of procedure.

5 PLANNING A RADIO NETWORK

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5.1 INSTALLATION PLANNING

This section provides tips for selecting an appropriate site, choosing an antenna system, and reducing the chance of harmful interference.

5.1.1 General Requirements

There are three main requirements for installing a transceiver—adequate and stable primary power, a good antenna system, and the correct interface between the transceiver and the data device. Figure 5-1 shows a typical Remote installation.

NOTE: The transceiver's network port supports 10BaseT and 100BaseT connections. Confirm that your hub/switch is capable of auto-switching data rates.

To prevent excessive Ethernet traffic from degrading performance, place the transceiver in a segment, or behind routers.

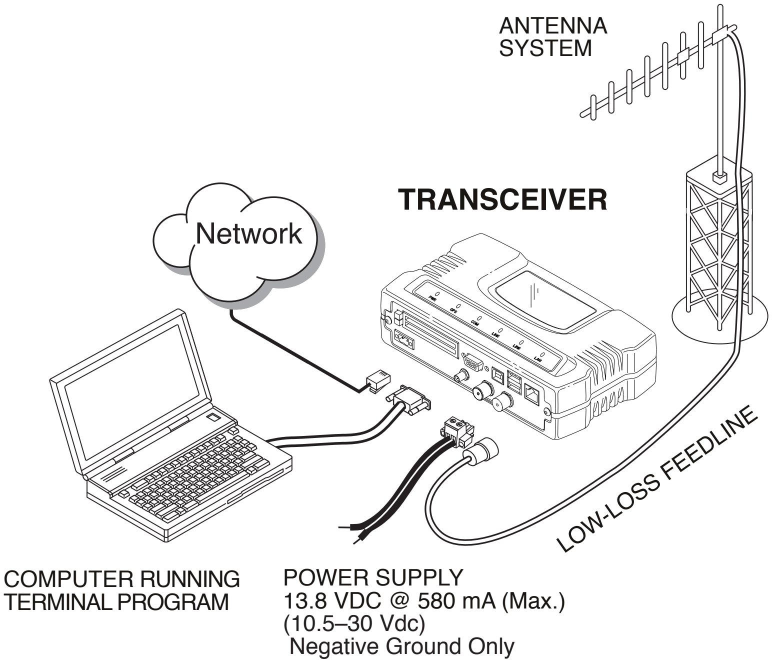

Figure 5-1. Typical Fixed Remote Installation With a Directional Antenna
(Connect user data equipment to any compatible LAN Port)

Unit Dimensions

Figure 5-2 on Page 166 shows the dimensions of the transceiver case and its mounting holes, and Figure 5-3 on Page 166 shows the dimensions for mounting with factory-supplied brackets. If possible, choose a mounting location that provides easy access to the connectors on the end of the radio and an unobstructed view of the LED status indicators.

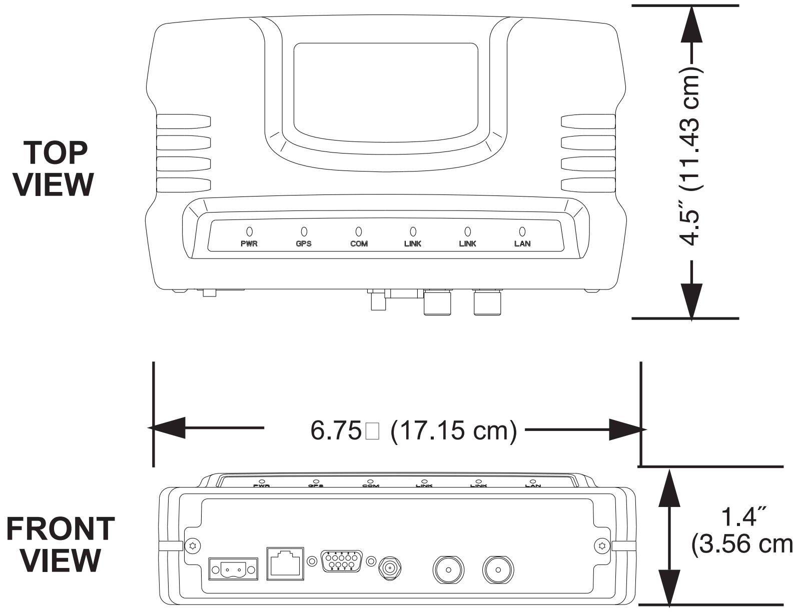

Figure 5-2. Transceiver Dimensions

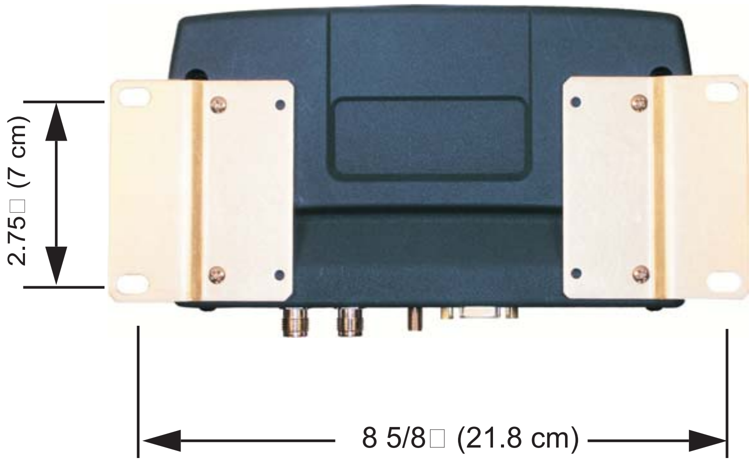

Figure 5-3. Mounting Bracket Dimensions
(Brackets secured to radio with 6-32 screws)

NOTE: To prevent moisture from entering the radio, do not mount the radio with the cable connectors pointing up. Also, dress all cables to prevent moisture from running along the cables and into the radio.

5.1.2 Site Selection

Suitable sites should provide:

- Protection from direct weather exposure
- A source of adequate and stable primary power
- Suitable entrances for antenna, interface, or other cabling
- An antenna location that provides a transmission path that is as unobstructed as possible in the direction of associated station(s)

With the exception of the transmission path, you can quickly determine these requirements. Radio signals travel primarily by line-of-sight, and obstructions between the sending and receiving stations will affect system performance. If you are not familiar with the effects of terrain and other obstructions on radio transmission, the discussion below will provide helpful background.

5.1.3 Terrain and Signal Strength

While the license-free bands offers many advantages for data transmission services, signal propagation is attenuated by obstructions such as terrain, foliage, or buildings in the transmission path. A line-of-sight transmission path between the central transceiver and its associated remote site(s) is highly desirable and provides the most reliable communications link.

Much depends on the minimum signal strength that can be tolerated in a given system. Although the exact figure will differ from one system to another, a Received Signal Strength Indication (RSSI) of –80 dBm or stronger will provide acceptable performance in most systems. While the equipment will work at lower-strength signals, signals stronger than – 77 dBm provide a *fade margin* of 15 dB to account for variations in signal strength that might occur. You can measure RSSI with a terminal connected to the COM1 port, or with an HTTP browser connected to the LAN (Ethernet) connector. (See *"Antenna Aiming (For Directional Antennas)"* on Page 160 for details.)

5.1.4 Antenna & Feedline Selection

NOTE: The transceiver must be installed by trained professional installers, or factory trained technicians.

The following text will help the professional installer in the proper methods of maintaining compliance with regulatory ERP limits.

Antennas

The radio equipment can be installed with a number of antennas. The exact style used depends on the physical size and layout of a system.

Contact your factory representative for specific recommendations on antenna types and hardware sources.

In general, an omnidirectional antenna (Figure 5-4) is used at the Access Points and mobile Remote stations. This provides equal signal coverage in all directions.

NOTE: Antenna polarization is important. If the wrong polarization is used, a signal reduction of 20 dB or more will result. Most systems using a gain-type omnidirectional antenna at Access Point stations employ vertical polarization of the signal; therefore, the Remote antenna(s) must also be vertically polarized (elements oriented perpendicular to the horizon).

When required, horizontally polarized omnidirectional antennas are also available. Contact your factory representative for details.

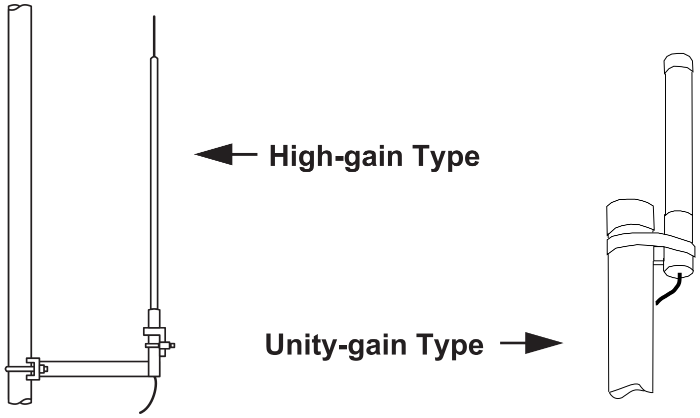

Figure 5-4. Typical Omnidirectional Antennas

At fixed Remote sites, a directional Yagi antenna (Figure 5-5 on Page 168) minimizes interference to and from other users. Antennas are available from a number of manufacturers.

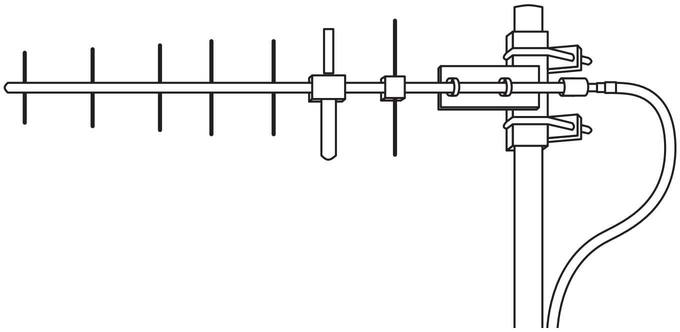

Figure 5-5. Typical Yagi Antenna (mounted to mast)

Diversity Reception (RX2) Antenna Port

Functional on some models. The RX2 antenna port allows connection of a second antenna to the transceiver for space diversity reception.

GPS Antennas

A number of GPS antennas (both active and passive) are available for use with the transceivers. Consult your factory representative for more information.

Feedlines

Carefully consider the choice of feedline used with the antenna. Avoid poor-quality coaxial cables, as they degrade system performance for both transmission and reception. A low-loss cable type such as Heliax® is recommended that is suitable for the frequency of operation. Keep the cable as short as possible to minimize signal loss.

Table 5-1 lists several types of popular feedlines and indicates the signal losses (in dB) that result when using various lengths of cable at 900 MHz. The choice of cable depends on the required length, cost considerations, and the acceptable amount of signal loss. Table 5-1 lists

Table 5-1. Length vs. Loss in Coaxial Cables at 900 MHz

Cable Type	10 Feet (3.05 m)	50 Feet (15.24 m)	100 Feet (30.48 m)	500 Feet (152.4 m)
RG-214	.76 dB	3.8 dB	7.6 dB	Unacceptable Loss
LMR-400	0.39 dB	1.95 dB	3.90 dB	Unacceptable Loss
1/2 inch HELIAX	0.23 dB	1.15 dB	2.29 dB	11.45 dB
7/8 inch HELIAX	0.13 dB	0.64 dB	1.28 dB	6.40 dB

several types of popular feedlines and indicates the signal losses (in dB) that result when using various lengths of cable at 900 MHz. The choice of cable depends on the required length, cost considerations, and the acceptable amount of signal loss.

Table 5-2. Length vs. Loss in Coaxial Cables at 3600 MHz

Cable Type	10 Feet (3.05 m)	50 Feet (15.24 m)	100 Feet (30.48 m)	500 Feet (152.4 m)
RG-214	3.04 dB	15.2 dB	Unacceptable Loss	Unacceptable Loss
LMR-400	1.56 dB	7.8 dB	15.6 dB	Unacceptable Loss
1/2 inch HELIAX	0.92 dB	4.6 dB	9.16 dB	Unacceptable Loss
7/8 inch HELIAX	0.52 dB	2.56 dB	5.12 dB	Unacceptable Loss

The tables below outline the minimum lengths of RG-214 coaxial cable that must be used with common GE MDS omnidirectional antennas in order to maintain compliance with FCC maximum limit of +36 dBi. If other coaxial cable is used, make the appropriate changes in loss figures.

NOTE: The authority to operate the transceiver in the USA may be void if antennas other than those approved by the FCC are used. Contact your factory representative for additional antenna information.

Table 5-3. Feedline Length vs. Antenna Gain*

(Required for Regulatory Compliance)

Antenna Gain (dBd)	Antenna Gain (dBi)	Minimum Feedline Loss (dB) that must be introduced for compliance	EIRP Level @ Min. Feedline Length	Maxrad Antenna Part No. (For 900 MHz Operation)
Unity (0 dB)	2.15 dBi	No minimum length	+32.15 dBm	Omni #MFB900
3 dBd	5.15 dBi	No minimum length	+35.15 dBm	Omni # MFB900
5 dBd	7.15 dBi	1.2 dB	+35.95 dBm	Omni # MFB900
6 dBd	8.15 dBi	2.2 dB	+35.95 dBm	Yagi # BMOY8903
9 dBd	11.15 dBi	7.15 dB	+35.25 dBm	Yagi # Z941
15.2 dBd	17.4 dBi	12 dB	+35.4 dBm	Andrew DB878G90A-XY

*Refer to Table 5-4 on Page 174 for allowable transceiver power settings for each antenna type.

NOTE: There is no minimum feedline length required when a 6 dBi gain or less antenna is used, as the EIRP will never exceed 36 dBm which is the maximum allowed, per FCC rules at 900 MHz. MDS 3650 models must not exceed 1-watt per MHz. Units must comply with the information given on Page 173 and the associated antenna tables. Only the manufacturer or a sub-contracted professional installer can adjust the transceiver’s RF output power.

The transceiver’s power output is factory set to maintain compliance with the FCC’s Digital Transmission System (DTS) Part 15 rules. These rules limit power to a maximum of 8 dBm/3 kHz, thus the transceiver is factory set to +29 dBm (900 model); 23 dBm (3650 model). When calculating maximum transceiver output for the 900 model, use +29 dBm if the antenna gain is 6 dBi or less (36 dBm ERP). See *How Much Output Power Can be Used?* below for power control with higher gain antennas. Refer to Page 173 and the associated antenna tables for both 900 and 3650 model compliance.

5.1.5 How Much Output Power Can be Used?

The transceiver is normally configured at the factory for a nominal RF power output of +29 dBm (900 model); +23 dBm (3650 model) this is the maximum transmitter output power allowed under FCC rules. The power must be *decreased* from this level if the antenna system gain exceeds 6 dBi (900 model). The allowable level is dependent on the antenna gain, feedline loss, and the transmitter output power setting.

NOTE: In some countries, the maximum allowable RF output might be limited to less than the figures referenced here. Be sure to check for and comply with the requirements for your area.

5.1.6 Conducting a Site Survey

If you are in doubt about the suitability of the radio sites in your system, it is best to evaluate them before a permanent installation is underway. You can do this with an on-the-air test (preferred method), or indirectly, using path-study software.

An on-the-air test is preferred because it allows you to see firsthand the factors involved at an installation site, and to directly observe the quality of system operation. Even if a computer path study was conducted earlier, perform this test to verify the predicted results.

Perform the test by first installing a radio and antenna at the proposed Access Point (AP) station site (one-per-system). Then visit the Remote site(s) with another transceiver (programmed as a remote) and a hand-held antenna. (A PC with a network adapter can be connected to each radio in the network to simulate data during this test, using the PING command.)

With the hand-held antenna positioned near the proposed mounting spot, a technician can check for synchronization with the Access Point station (shown by a lit LINK LED on the front panel), then measure the reported RSSI value. (See *"Antenna Aiming (For Directional Antennas)"* on Page 160 for details.) If you cannot obtain adequate signal strength, it might be necessary to mount the station antennas higher, use higher gain antennas, select a different site, or install a repeater station. To prepare the equipment for an on-the-air test, follow the general installation procedures given in this guide and become familiar with the operating instructions found in the *CHAPTER-2 TABLETOP EVALUATION AND TEST SETUP* on Page 21.

5.1.7 A Word About Radio Interference

The transceiver shares the radio-frequency spectrum with other services and users. Completely error-free communications might not be achievable in a given location, and some level of interference should be expected. However, the radio's flexible design and hopping techniques should allow adequate performance as long as you carefully choose the station location, configuration of radio parameters, and software/protocol techniques.

In general, keep the following points in mind when setting up your communications network:

- Systems installed in rural areas are least likely to encounter interference; those in suburban and urban environments are more likely to be affected by other devices operating in the license-free frequency band and by adjacent licensed services.
- Use a directional antenna at remote sites whenever possible. Although these antennas may be more costly than omnidirectional types, they confine the transmission and reception pattern to a comparatively narrow lobe, minimizing interference to (and from) stations located outside the pattern.
- If interference is suspected from a nearby licensed system (such as a paging transmitter), it might be helpful to use horizontal polarization of all antennas in the network. Because most other services use vertical polarization in this band, you can achieve an additional 20 dB of attenuation to interference by using horizontal polarization. Another approach is to use a bandpass filter to attenuate all signals outside the desired band.
- Multiple Access Point units can co-exist in proximity to each other with no interference. The APs should be configured to operate in TDD Sync Mode, where their transmissions are synchronized to GPS timing. See *"Protected Network Operation using Multiple APs"* on Page 16. For additional isolation, separate directional antennas with as much vertical or horizontal separation as is practical.
- The power output of all radios in a system should be set for the lowest level necessary for reliable communications. This reduces the chance of causing unnecessary interference to nearby systems and also keeps power consumption to a minimum.

Configuring Mercury 3650 for Shared Spectrum Use (Contention-Based Protocol)

While the Mercury 3650 has been designed to reduce the effects of interferers outside of the RF channel, cases may arrive where interferers may cause undesired operation. In the case of WiMAX interferers, proper configuration of the radio may reduce these effects.

The radio employs a WiMAX contention protocol that effectively reduces the amount of interference the network may cause to other co-located WiMAX networks using the same channel. In addition, proper configuration of the radio will help to reduce the effects of other WiMAX hardware attempting to do the same.

Remote radios receive scheduling information from a central base station (AP). This scheduling information destined for a given remote includes when to transmit, the duration of transmission, and modulation selection. In the event the intended Remote unit is unable to receive or interpret this information from the AP, the Remote will persist in receive mode only.

The radio allows the installer to configure an Approved Access Point list that contains the MAC addresses of desired AP radios in the network. When an Access Point sends scheduling data to the Remote unit, the Remote compares the MAC Address of the AP to this approved MAC address list, and discards the scheduling information if it has originated from a “foreign” network.

In order to maximize the performance of a shared network, the following configuration is recommended:

1. The Mercury 3650 network should be set to operate on the same channel frequency as the network the channel is shared with. Slight offsets in frequency between two collocated systems will cause on-channel interference that is not decodable by either system. Having both systems operate on the same frequency allows the radio to decode WiMAX scheduling information from the interfering AP.

2. Configure the approved AP list using the AP Locations file as specified in the *AP Location Push Config Menu* on Page 63. After the Remote unit has received scheduling information from the interfering network, it will compare the MAC address of this radio to its AP Locations File. When the MAC address does not match, the radio will ignore this information from the interfering AP and continue to wait for valid scheduling information from an AP in the desired network.

5.1.8 EIRP Compliance at 900 MHz

To determine the maximum allowable power setting of the radio, perform the following steps:

1. Determine the antenna system gain by subtracting the feedline loss (in dB) from the antenna gain (in dBi). For example, if the antenna gain is 9.5 dBi, and the feedline loss is 1.5 dB, the antenna system gain would be 8 dB. (If the antenna system gain is 6 dB or less, no power adjustment is required.)

2. Subtract the antenna system gain from 36 dBm (the maximum allowable EIRP). The result indicates the maximum transmitter power (in dBm) allowed under the rules. In the example above, this is 28 dBm.

3. Set the transmitter power so that it does not exceed the maximum level determined in Step 2.
(**Main Menu>>Radio Configuration>>Transmit Power**)

Refer to Table 5-4, which lists several antenna system gains and shows the maximum allowable power setting of the radio. Note that a gain of 6 dB or less entitles you to operate the radio at full power output –30 dBm.

For MDS 3650 units, refer also to the section titled *EIRP Compliance at 3650 MHz* below.

Table 5-4. Antenna Gain vs. Power Setpoint (900 MHz)

Antenna System Gain **(Antenna Gain in dBi* minus Feedline Loss in dB)**	**Maximum Power Setting (PWR command)**	**EIRP** **(in dBm)**
Omni 6 (or less)	29	35
Omni 11	25	36
Yagi 11	23	36
Half Parabolic 16	20	36
Panel 17.4**	20	36

* Most antenna manufacturers rate antenna gain in dBd in their literature. To convert to dBi, add 2.15 dB.

** Must use with the appropriate length of feedline cable to reduce transmitter power by at least 2 dB. Feedline loss varies by cable type and length. To determine the loss for common lengths of feedline, see Table 5-1 on Page 169.

5.1.9 EIRP Compliance at 3650 MHz

To maintain regulatory compliance for Effective Isotropic Radiated Power (EIRP) of **1-Watt per MHz**, the following table of transmit power settings must be observed for the listed bandwidths and antenna types approved. Consult the factory for other antenna options of lower gain.

Table 5-5. Antenna Gain vs. Power Setpoint (3650 MHz)

Antenna Gain (dBi)	Radio Configuration (Antenna Type/Radio Bandwidth))	Radio Power Setpoint (dBm)
13	Omni Antenna, 1.75 MHz BW	22
13	Omni Antenna, 3.5 MHz BW	23
13	Omni Antenna, 5 MHz BW	23
13	Omni Antenna, 7 MHz BW	23
13	Omni Antenna, 10 MHz BW	23
13	Omni Antenna, 14 MHz BW	23
18	Panel Antenna, 1.75 MHz BW	17
18	Panel Antenna, 3.5 MHz BW	20
18	Panel Antenna, 5 MHz BW	22
18	Panel Antenna, 7 MHz BW	23
18	Panel Antenna, 10 MHz BW	23
18	Panel Antenna, 14 MHz BW	23

The antennas used to support operation in this band must be fixed mounted.

5.2 dBm-WATTS-VOLTS CONVERSION CHART

Table 5-6 is provided as a convenience for determining the equivalent voltage or wattage of an RF power expressed in dBm.

Table 5-6. dBm-Watts-Volts conversion—for 50 ohm systems

dBm	V	Po
+53	100.0	200W
+50	70.7	100W
+49	64.0	80W
+48	58.0	64W
+47	50.0	50W
+46	44.5	40W
+45	40.0	32W
+44	32.5	25W
+43	32.0	20W
+42	28.0	16W
+41	26.2	12.5W
+40	22.5	10W
+39	20.0	8W
+38	18.0	6.4W
+37	16.0	5W
+36	14.1	4W
+35	12.5	3.2W
+34	11.5	2.5W
+33	10.0	2W
+32	9.0	1.6W
+31	8.0	1.25W
+30	7.10	1.0W
+29	6.40	800mW
+28	5.80	640mW
+27	5.00	500mW
+26	4.45	400mW
+25	4.00	320mW
+24	3.55	250mW
+23	3.20	200mW
+22	2.80	160mW
+21	2.52	125mW
+20	2.25	100mW
+19	2.00	80mW
+18	1.80	64mW
+17	1.60	50mW
+16	1.41	40mW
+15	1.25	32mW
+14	1.15	25mW
+13	1.00	20mW
+12	.90	16mW
+11	.80	12.5mW
+10	.71	10mW
+9	.64	8mW
+8	.58	6.4mW
+7	.500	5mW
+6	.445	4mW
+5	.400	3.2mW
+4	.355	2.5mW
+3	.320	2.0mW
+2	.280	1.6mW
+1	.252	1.25mW

dBm	V	Po
0	.225	1.0mW
-1	.200	.80mW
-2	.180	.64mW
-3	.160	.50mW
-4	.141	.40mW
-5	.125	.32mW
-6	.115	.25mW
-7	.100	.20mW
-8	.090	.16mW
-9	.080	.125mW
-10	.071	.10mW
-11	.064	
-12	.058	
-13	.050	
-14	.045	
-15	.040	
-16	.0355	

dBm	mV	Po
-17	31.5	
-18	28.5	
-19	25.1	
-20	22.5	.01mW
-21	20.0	
-22	17.9	
-23	15.9	
-24	14.1	
-25	12.8	
-26	11.5	
-27	10.0	
-28	8.9	
-29	8.0	
-30	7.1	.001mW
-31	6.25	
-32	5.8	
-33	5.0	
-34	4.5	
-35	4.0	
-36	3.5	
-37	3.2	
-38	2.85	
-39	2.5	
-40	2.25	.1□W
-41	2.0	
-42	1.8	
-43	1.6	
-44	1.4	
-45	1.25	
-46	1.18	
-47	1.00	
-48	0.90	

dBm	mV	Po
-49	0.80	
-50	0.71	.01□W
-51	0.64	
-52	0.57	
-53	0.50	
-54	0.45	
-55	0.40	
-56	0.351	
-57	0.32	
-58	0.286	
-59	0.251	
-60	0.225	.001□W
-61	0.200	
-62	0.180	
-63	0.160	
-64	0.141	

dBm	□V	Po
-65	128	
-66	115	
-67	100	
-68	90	
-69	80	
-70	71	.1nW
-71	65	
-72	58	
-73	50	
-74	45	
-75	40	
-76	35	
-77	32	
-78	29	
-79	25	
-80	22.5	.01nW
-81	20.0	
-82	18.0	
-83	16.0	
-84	11.1	
-85	12.9	
-86	11.5	
-87	10.0	
-88	9.0	
-89	8.0	
-90	7.1	.001nW
-91	6.1	
-92	5.75	
-93	5.0	
-94	4.5	
-95	4.0	
-96	3.51	
-97	3.2	

dBm	□V	Po
-98	2.9	
-99	2.51	
-100	2.25	.1pW
-101	2.0	
-102	1.8	
-103	1.6	
-104	1.41	
-105	1.27	
-106	1.18	

dBm	nV	Po
-107	1000	
-108	900	
-109	800	
-110	710	.01pW
-111	640	
-112	580	
-113	500	
-114	450	
-115	400	
-116	355	
-117	325	
-118	285	
-119	251	
-120	225	.001pW
-121	200	
-122	180	
-123	160	
-124	141	
-125	128	
-126	117	
-127	100	
-128	90	
-129	80	.1˜W
-130	71	
-131	61	
-132	58	
-133	50	
-134	45	
-135	40	
-136	35	
-137	33	
-138	29	
-139	25	
-140	23	.01˜W

6 TECHNICAL REFERENCE

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Digital Energy
MDS

6.1 DATA INTERFACE CONNECTORS

Two types of data interface connectors are provided on the front panel of the transceiver—an RJ-45 LAN port, and a DB-9 serial port (COM1), which uses the RS-232 (EIA-232) signaling standard.

CAUTION

RADIO FREQUENCY INTERFERENCE POTENTIAL

The transceiver meets U.S.A.'s FCC Part 15, Class A limits when used with shielded data cables.

6.1.1 LAN Port

Use the transceiver's LAN port to connect the radio to an Ethernet network. The transceiver provides a data link to an Internet Protocol-based (IP) network via the Access Point station. Each radio in the network must have a unique IP address for the network to function properly.

- To connect a PC directly to the radio's LAN port, an RJ-45 to RJ-45 cross-over cable is required.
- To connect the radio to a Ethernet hub or bridge, use a straight-through cable.

The connector uses the standard Ethernet RJ-45 cables and wiring. For custom-made cables, use the pinout information in Figure 6-1 and Table 6-1.

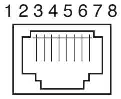


Figure 6-1. LAN Port (RJ-45) Pinout
(Viewed from the outside of the unit)

Table 6-1. LAN Port (IP/Ethernet)

Pin	Functions	Ref.
1	Transmit Data (TX)	High
2	Transmit Data (TX)	Low
3	Receive Data (RX)	High
4	Unused	
5	Unused	
6	Receive Data (RX)	Low
7	Unused	
8	Unused	

6.1.2 COM1 Port

The COM1 serial port is a standard DB-9 female connector. Connect a PC to the transceiver via this port with a DB-9M to DB-9F “straight-through” cable. These cables are available commercially, or may be constructed using the pinout information in Table 6-2.

Table 6-2. COM1 Port Pinout, DB-9F/RS-232 Interface

Pin	Functions	DCE
1	Unused	
2	Receive Data (RXD)	<—[Out
3	Transmit Data (TXD)	—>[In
4	Unused	
5	Signal Ground (GND)	
6–9	Unused	

6.2 SPECIFICATIONS

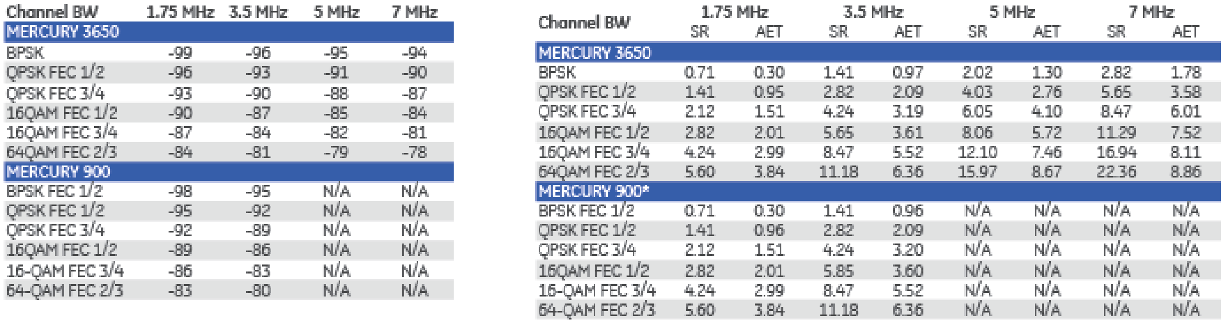
General

- Raw Bit Rate: from 600 kbps to 12.7 Mbps
- Frequency Bands: 902-928 MHz ISM band
  3.65-3.7 GHz Registered FCC band
- Bandwidths: 900 model—1.75, 3.5 MHz
  3650 model—1.75, 3.5, 5, 7 MHz
- Orthogonal Frequency Division Multiplexing (OFDM)
  - 200 Carriers per Channel
- Available Configurations:
  - Access Point: Ethernet, Serial, GPS
  - Remote: Ethernet, Serial, GPS

Radio

- System Gain: 140 dB for 1.75 MHz channel, 137 dB for 3.5 MHz channel
- Carrier Power—AP: -30 to +29 dBm, RM: 0 to +29 dBm (900 models); +23 dBm max. (3650 model)
- RF Output Impedance: 50 Ohms
- Sensitivity and Signal Rate (see Table 6-3):

Table 6-3. Sensitivity and Signal Rate



Channel BW	1.75 MHz	3.5 MHz	5 MHz	7 MHz
MERCURY 3650				
BPSK	-99	-96	-95	-94
QPSK FEC 1/2	-96	-93	-91	-90
QPSK FEC 3/4	-93	-90	-88	-87
16QAM FEC 1/2	-90	-87	-85	-84
16QAM FEC 3/4	-87	-84	-82	-81
64QAM FEC 2/3	-84	-81	-79	-78
MERCURY 900				
BPSK FEC 1/2	-98	-95	N/A	N/A
QPSK FEC 1/2	-95	-92	N/A	N/A
QPSK FEC 3/4	-92	-89	N/A	N/A
16QAM FEC 1/2	-89	-86	N/A	N/A
16-QAM FEC 3/4	-86	-83	N/A	N/A
64-QAM FEC 2/3	-83	-80	N/A	N/A

Channel BW	1.75 MHz		3.5 MHz		5 MHz		7 MHz	
	SR	AET	SR	AET	SR	AET	SR	AET
MERCURY 3650								
BPSK	0.71	0.30	1.41	0.97	2.02	1.30	2.82	1.78
QPSK FEC 1/2	1.41	0.95	2.82	2.09	4.03	2.76	5.65	3.58
QPSK FEC 3/4	2.12	1.51	4.24	3.19	6.05	4.10	8.47	6.01
16QAM FEC 1/2	2.82	2.01	5.65	3.61	8.06	5.72	11.29	7.52
16QAM FEC 3/4	4.24	2.99	8.47	5.52	12.10	7.46	16.94	8.11
64QAM FEC 2/3	5.60	3.84	11.18	6.36	15.97	8.67	22.36	8.86
MERCURY 900*								
BPSK FEC 1/2	0.71	0.30	1.41	0.96	N/A	N/A	N/A	N/A
QPSK FEC 1/2	1.41	0.96	2.82	2.09	N/A	N/A	N/A	N/A
QPSK FEC 3/4	2.12	1.51	4.24	3.20	N/A	N/A	N/A	N/A
16QAM FEC 1/2	2.82	2.01	5.85	3.60	N/A	N/A	N/A	N/A
16-QAM FEC 3/4	4.24	2.99	8.47	5.52	N/A	N/A	N/A	N/A
64-QAM FEC 2/3	5.60	3.84	11.18	6.36	N/A	N/A	N/A	N/A

Note that the transceiver is a half-duplex radio, so maximum user throughput is based on a configured or dynamic duty cycle, which is typically 50/50 indicating that half of the maximum throughput would be available one way. The maximum user throughput is also based on high protocol overhead from TCP/IP applications. For UDP applications, these throughput numbers will increase.

Physical Interface

- Ethernet: 10/100BaseT, RJ-45
- Serial: 1,200 – 115,200 bps
  - COM1: RS-232, DB-9F
- Antennas: TX/RX–TNC connector, GPS—SMA connector
- LED Indicators: PWR, COM1, LINK, LAN

Protocols (Pending—contact factory for details)

- Ethernet: IEEE 802.3, Spanning Tree (Bridging), VLAN, IGMP
- TCP/IP: DHCP, ICMP, UDP, TCP, ARP, Multicast, SNTP, TFTP
- Serial: Encapsulation over IP (tunneling) for serial async multidrop protocols including MODBUS™, DNP.3, DF1, BSAP

GE MDS Cyber Security Suite, Level 1

- Encryption: AES-128.
- Authentication: 802.1x, RADIUS, EAP/TLS, PKI, PAP, CHAP
- Management: SSL, SSH, HTTPS

Management

- HTTP, HTTPS, TELNET, SSH, local console
- SNMPv1/v2/v3, MIB-II, Enterprise MIB
- SYSLOG
- MDS NETview MS™ compatible

Environmental

- Temperature: -40°C to +70°C (-40°F to +158°F)
- Humidity: 95% at 40°C (104°F) non-condensing
- MTBF (Reliability): Consult factory for on-file data

Electrical

- Input Power: 10-30 Vdc
- Current Consumption (nominal):

Mode	Power	13.8 Vdc	24 Vdc
AP Transmit	25 W	1.8 A	1.0 A
AP Receive	8 W	579 mA	333 mA
RM Transmit	25W	1.8 mA	1.0 A
RM Receive	6.5W	471 mA	270 mA

Mechanical

- Case: Die Cast Aluminum
- Dimensions: 5.715 H x 20 W x 12.382 D cm. (2.25 H x 7.875 W x 4.875 D in.)
- Weight: 1kg (2.2 lb.)
- Mounting options: Flat surface mount brackets, DIN rail, 19" rack tray

External GPS PPS Option

Parameter	Minimum	Maximum
Pulse Voltage (logic low)	0 V	1 V
Pulse Voltage (logic high)	1.7 V	10 V
Source Impedance (ohms)	—	200 Ω
Duty Cycle (ton)	0.0001% (1µsec)	50% (0.5 sec)
Operating Frequency	0.99999999 Hz (-0.1 ppm error)	1.00000001 Hz (+0.1 ppm error)
Module Clamping Voltage	2.7 V	3.3 V
Module Input Resistance	150 Ω (Vin >2.6 V)	10 kΩ (Vin < 2 V)
Input Hysteresis	7 mV	N/A

Agency Approvals

- FCC Part 15.247 (DTS)—900 model
- FCC Part 90—3650 model
- CSA Class 1 Div. 2, (CSA C22.2-213-M1987 & CSA C22.2-142-M1987) (UL1604 & UL916)
- IC RSS-210 "Issue 7"

NOTE: GE MDS products are manufactured under a quality system certified to ISO 9001. GE MDS reserves the right to make changes to specifications of products described in this manual at any time without notice and without obligation to notify any person of such changes.

6.3 NOTES ON SNMP

6.3.1 Overview

The firmware release described in this manual contains changes to the transceiver's SNMP Agent, several new MIB variables, and new Agent configuration options. This guide reviews the changes and shows how to properly configure the Agent to take advantage of these new features.

SNMPv3 Support

The updated SNMP Agent now supports SNMP version 3 (SNMPv3). The SNMPv3 protocol introduces Authentication (MD5/SHA-1), Encryption (DES), the USM User Table, and View-Based Access (refer to RFC2574 for full details). The SNMP Agent has limited SNMPv3 support in the following areas:

- Only MD5 Authentication is supported (no SHA-1). SNMPv3 provides support for MD5 and SHA-1.
- Limited USM User Table Manipulation. The SNMP Agent starts with 5 default accounts. New accounts can be added (SNMPv3 adds new accounts by cloning existing ones), but they will be volatile (will not survive a power-cycle).

  New views cannot be configured on the SNMP Agent. Views are inherited for new accounts from the account that was cloned.

  The SNMP Agent uses one password pair (Authentication/Privacy) for all accounts. This means that when the passwords change for one user, they change for all users.

SNMPv3 Accounts

The following default accounts are available for the SNMP Agent:

enc_mdsadmin—Read/write account using Authentication and Encryption.

auth_mdsadmin—Read/write account using Authentication.

enc_mdsviewer—Read only account using Authentication and Encryption.

auth_mdsviewer—Read only account using Authentication.

def_mdsviewer—Read only account with no Authentication or Encryption.

Context Names

The following Context Names are used (refer to RFC2574 for full details):

Admin accounts: **context_a**/Viewer accounts: **context_v**.

All accounts share the same default passwords:

Authentication default password: **MDSAuthPwd**/Privacy default password: **MDSPrivPwd.**

Passwords can be changed either locally (via the console) or from an SNMP Manager, depending on how the Agent is configured. If passwords are configured and managed locally, they are non-volatile and will survive a power-cycle. If passwords are configured from an SNMP manager, they will be reset to whatever has been stored for local management on power-cycle.

This behavior was chosen based on RFC specifications. The SNMP Manager and Agent do not exchange passwords, but actually exchange *keys* based on passwords. If the Manager changes the Agent's password, the Agent does not know the new password. The Agent only knows the new key. In this case, only the Manager knows the new password. This could cause problems if the Manager loses the password. If that happens, the Agent becomes unmanageable. Resetting the Agent's passwords (and therefore keys) to what is stored in flash memory upon power-cycle prevents the serious problem of losing the Agent's passwords.

If passwords are managed locally, they can be changed on the Agent (via the console). Any attempts to change the passwords for the Agent via an SNMP Manager will fail when the Agent is in this mode. Locally defined passwords will survive a power-cycle.

In either case, the SNMP Manager needs to know the initial passwords being used in order to talk to the Agent. If the Agent's passwords are configured via the Manager, they can be changed from the Manager. If the passwords are managed locally, then the Manager must be re-configured with any password changes in order to continue talking to the Agent.

Password-Mode Management Changes

When the password management mode is changed, the active passwords used by the Agent may also change. Some common scenarios are discussed below:

Common Scenarios

- Passwords are currently being handled by the Manager. The assigned passwords are **Microwave** (Auth), and **Rochester** (Priv). Configuration is changed to manage the passwords locally. The passwords stored on the radio were Fairport (Auth), and Churchville (Priv) (if local passwords have *never* been used, then MDSAuthPwd and MDSPrivPwd are used). These passwords will now be used by the Agent to re-generate keys. The Manager must know these passwords to talk to the Agent.
- Passwords are currently managed locally. The local passwords are **Fairport** (Auth) and **Churchville** (Priv). Configuration is changed to handle the passwords from the Manager. The same passwords will continue to be used, but now the Manager can change them.
- Passwords are currently managed locally. The local passwords are **Fairport** (Auth) and **Churchville** (Priv). Passwords are changed to **Brighton** (Auth) and **Perinton** (Priv). The Agent will immediately generate new keys based on these passwords and start using them. The Manager will have to be re-configured to use these new passwords.

- Passwords are currently managed locally. The local passwords are **Fairport** (Auth) and **Churchville** (Priv). Configuration is changed to handle the passwords from the Manager. The Manager changes the passwords to **Brighton** (Auth) and **Perinton** (Priv). The radio is then rebooted. After a power-cycle, the radio will use the passwords stored in flash memory, which are **Fairport** (Auth) and **Churchville** (Priv). The Manager must be re-configured to use these new passwords.

Table 6-4. SNMP Traps *(Sorted by Code)*

SNMP Trap	Severity	Description
bootup(34)	CRITICAL	System Bootup
reboot(35)	MAJOR	User Selected Reboot
reprogStarted(36)	INFORM	Reprogramming Started
reprogCompleted(37)	INFORM	Reprogramming Completed
reprogFailed(38)	MAJOR	Reprogramming Failed
telnetLogin(39)	MAJOR	Telnet/SSH User login/logout
httpLogin(40)	MAJOR	HTTP User login/logout
logClear(41)	INFORM	Event Log Cleared
dhcpServer(42)	INFORM	DHCP server enabled/disabled
dhcpClient(43)	INFORM	DHCP client enabled/disabled
dhcpAddr(44)	MINOR	Obtained DHCP address
timeNotSet(45)	INFORM	Date/time not set
timeByUser(46)	INFORM	Date/time changed by user
timeFromServer(47)	INFORM	Date/time from server
consoleLogin(48)	MAJOR	Console user login/logout
httpLockdown(49)	MAJOR	HTTP Access locked down
parmChanged(50)	INFORM	Parameter changed
cfgscript(51)	INFORM	Configuration script generated/received
authKey(52)	MAJOR	Authorization key entered - valid/invalid
authDemo(53)	MAJOR	Demo authorization enabled/expired
maxDemos(54)	CRITICAL	Max demos reset/reached
modemRestart(55)	MAJOR	Modem restarted
internalError(56)	MAJOR	Internal error
gpsRestarted(57)	MAJOR	GPS Restarted
remoteConnection(58)	INFORM	Remote associated/disassociated
imageCopyStarted(59)	INFORM	Firmware image copy started
imageCopyComplete(60)	INFORM	Firmware image copy complete
imageCopyFailed(61)	MAJOR	Firmware image copy failed
connectionStatus(64)	INFORM	Connection status change
connAbort(65)	MAJOR	Connection aborted
authenticating(66)	INFORM	Authenticating to Access Point

Table 6-4. SNMP Traps *(Sorted by Code)* ***(Continued)***

SNMP Trap	Severity	Description
association(67)	MAJOR	Associated to Access Point established/lost
redundLackRem(72)	MAJOR	Lack of associated remotes exceeded threshold for P21 AP
redundRecvErr(73)	MAJOR	Packet receive errors exceeded threshold for P21 AP
redundForced(74)	MAJOR	P21 AP forced switchover
redundancySwitch(75)	MAJOR	P21 AP auto switchover
radioError(76)	CRITICAL	Radio error
procopen(77)	MAJOR	Proc filesystem access failed
procformat(78)	MAJOR	Unexpected proc filesystem format
csropen(79)	MAJOR	Failed to open CSR device
csrstatus(80)	MAJOR	CSR read failed
csrctrlsignal(81)	MAJOR	CSR write failed
bandwidthMismatch(83)	INFORM	Bandwidth of AP in Locations file does not match this unit
gpsSync(84)	INFORM	GPS synchronized/lost sync
gpsTddSync(85)	INFORM	TDD synchronized/lost sync
tftpClientConn(86)	INFORM	TFTP Connection to Client Opened/Closed
tftpClientError(87)	MAJOR	Error in TFTP Transfer to Client
autoUpgrade(88)	MAJOR	Auto Firmware Upgrade Retry Scheduled/Starting
autoReboot(89)	MAJOR	Auto Firmware Boot Failed/Starting
certVerify(90)	CRITICAL	X.509 certificates loaded/failed
certChainVerify(91)	CRITICAL	Certificate chain verified/invalid
paTemp(92)	MAJOR	PowerAmp temperature Normal/Too hot

6.4 NOTES ON WPA/WPA2 WiFi SECURITY

The Mercury Remote with WiFi includes support for 802.11 (WiFi) networks. A Remote with WiFi may be set up as a WiFi Access Point, Station, or in Ad Hoc mode. Further, standard WiFi encryption modes are supported. The Remote with WiFi offers a choice of WEP64, WEP128, WPA-PSK, WPA Enterprise, WPA2, or WPA2 Enterprise security modes to create a secure WiFi network.

The following provides an example for using WPA2 Enterprise mode to secure an 802.11 (WiFi) network.

1. Simple WiFi Network Configuration

A simple WiFi configuration is the connection between a Remote with WiFi set up as a WiFi *Access Point* (AP), and another Remote with WiFi set up as a WiFi *Station*. The WiFi access point may be connected to the network through a wired Ethernet link, or through a WiMax connection to a Mercury AP. Figure 6-1 shows a typical network setup.

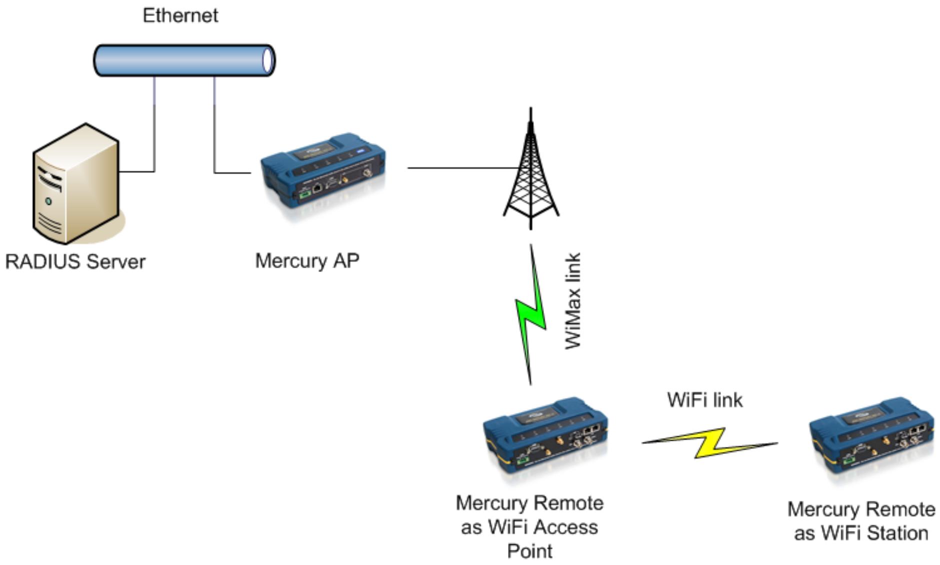

Ethernet
RADIUS Server
Mercury AP
WiMax link
WiFi link
Mercury Remote as WiFi Access Point
Mercury Remote as WiFi Station

Figure 6-1. Sample Network Setup with a WiFi Link Between Two Mercury Remotes

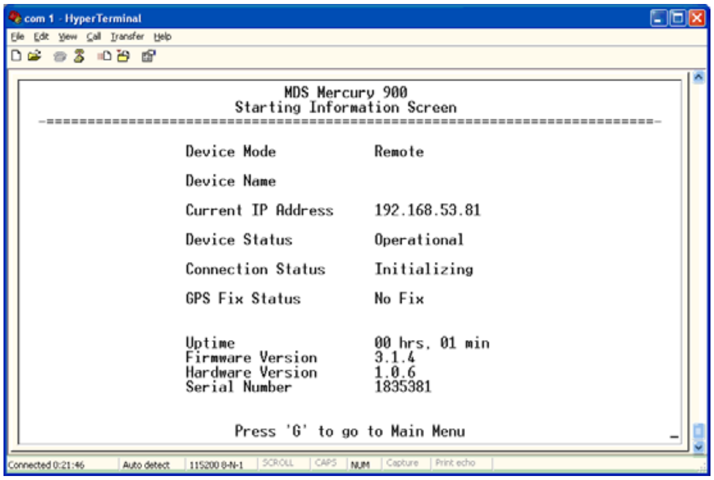
2. Connection to RADIUS Server

To utilize WPA2 Enterprise security on the WiFi network, the WiFi access point must have a network connection to a RADIUS server that will be used to authenticate the WiFi station.

The RADIUS server must be configured to support EAP-TLS authentication. Consult your RADIUS server's documentation for instructions.

3. Create Certificates

For the WiFi station to successfully authenticate, you will need to generate certificates. Three certificates are required: A *root* certificate from the generating certificate authority, a *client* certificate, and a *private key*. All certificates must be signed by the certificate authority, and they must be in **.der** format. When generating client certificates and private keys, use the unit's serial number as the Common Name. The serial number can be found on the Starting Information Screen shown in Figure 6-2.

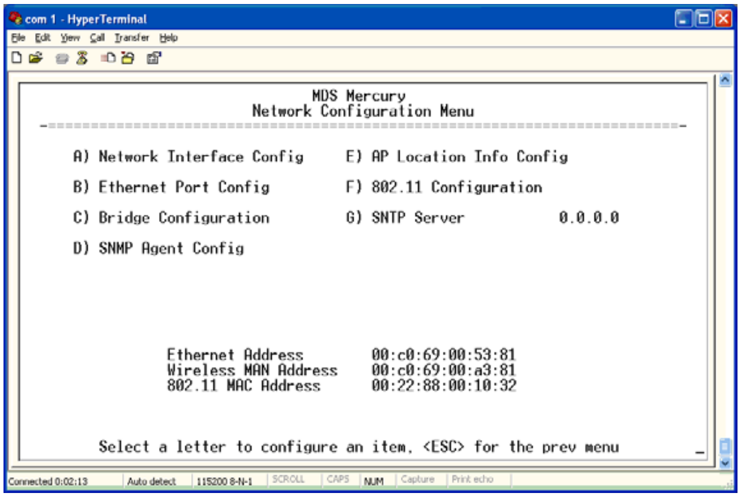


```
                        MDS Mercury 900
                   Starting Information Screen
-===========================================================================-

                 Device Mode            Remote

                 Device Name

                 Current IP Address     192.168.53.81

                 Device Status          Operational

                 Connection Status      Initializing

                 GPS Fix Status         No Fix


                 Uptime                 00 hrs, 01 min
                 Firmware Version       3.1.4
                 Hardware Version       1.0.6
                 Serial Number          1835381

                       Press 'G' to go to Main Menu
```

Figure 6-2. Starting Information Screen

3. Configuring the WiFi Access Point

To setup a Remote with WiFi as a WiFi Access Point, start at the Main Menu and press **B** to access the Network Configuration menu shown in Figure 6-3.



```
                            MDS Mercury
                     Network Configuration Menu
-===========================================================================-

      A) Network Interface Config       E) AP Location Info Config

      B) Ethernet Port Config           F) 802.11 Configuration

      C) Bridge Configuration           G) SNTP Server          0.0.0.0

      D) SNMP Agent Config




                 Ethernet Address        00:c0:69:00:53:81
                 Wireless MAN Address    00:c0:69:00:a3:81
                 802.11 MAC Address      00:22:88:00:10:32


         Select a letter to configure an item, <ESC> for the prev menu
```

Figure 6-3. Network Configuration Menu

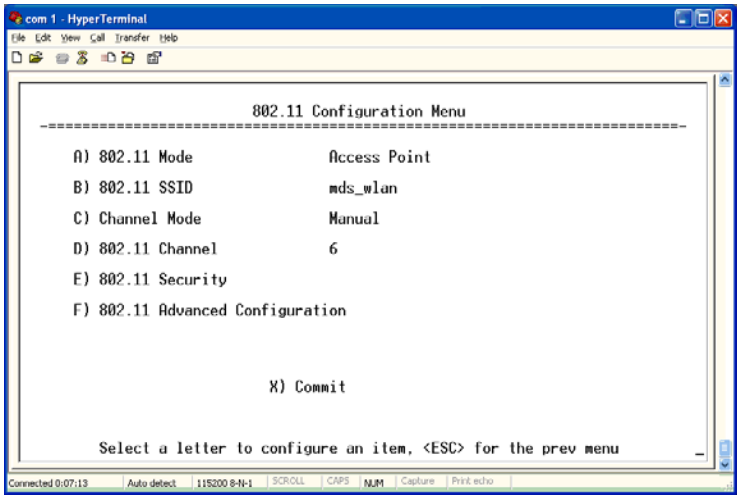
From the Network Configuration menu, press **F** to access the 802.11 Configuration Menu. You will need to set the following options:

a. **802.11 Mode**—Select **Access Point.**

b. **802.11 SSID**—Enter a name for your WiFi network.

c. **Channel Mode**—Select Dynamic or Manual Channel Mode. If you use Dynamic Channel Mode, the unit will automatically use the channel with the least amount of activity.

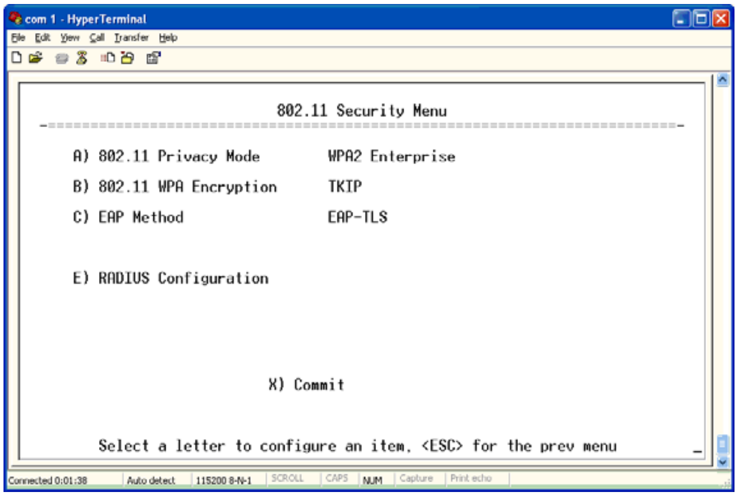
d. **Channel**—This option is only available in Manual Channel Mode.



```
com 1 - HyperTerminal

                    802.11 Configuration Menu
 -==========================================================================-

      A) 802.11 Mode                  Access Point
      B) 802.11 SSID                  mds_wlan
      C) Channel Mode                 Manual
      D) 802.11 Channel               6
      E) 802.11 Security
      F) 802.11 Advanced Configuration


                           X) Commit

        Select a letter to configure an item, <ESC> for the prev menu

Connected 0:07:13   Auto detect   115200 8-N-1   SCROLL   CAPS   NUM   Capture   Print echo
```

Figure 6-4. Configuration Menu as a WiFi Access Point

Press **X** to commit your settings. Next, press **E** to enter the 802.11 Security Menu shown in Figure 6-5.



```
com 1 - HyperTerminal

                       802.11 Security Menu
 -==========================================================================-

      A) 802.11 Privacy Mode          WPA2 Enterprise
      B) 802.11 WPA Encryption        TKIP
      C) EAP Method                   EAP-TLS


      E) RADIUS Configuration



                           X) Commit

        Select a letter to configure an item, <ESC> for the prev menu

Connected 0:01:38   Auto detect   115200 8-N-1   SCROLL   CAPS   NUM   Capture   Print echo
```

Figure 6-5. Security Menu as a WiFi Access Point

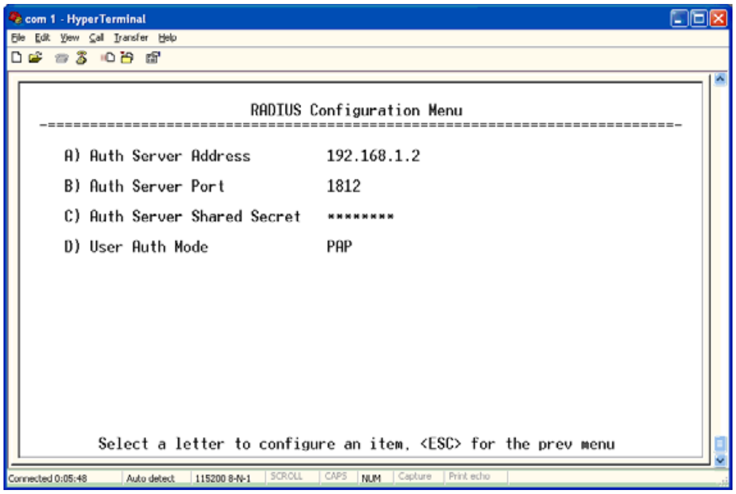
For your WiFi network to use WPA2 Enterprise security, you will need to set the following options in the 802.11 Security Menu.

a. **802.11 Privacy Mode**—Select **WPA2 Enterprise**.

b. **802.11 WPA Encryption**—Choose TKIP or CCMP encryption.

c. **EAP Method**—Currently, EAP-TLS is the supported EAP method.

Press **X** to commit your changes, then press **E** to enter the RADIUS Configuration Menu (Figure 6-6).



```
                         RADIUS Configuration Menu
 -=============================================================================-

    A) Auth Server Address          192.168.1.2

    B) Auth Server Port             1812

    C) Auth Server Shared Secret    ********

    D) User Auth Mode               PAP










          Select a letter to configure an item, <ESC> for the prev menu
```

Figure 6-6. RADIUS Configuration Menu

The RADIUS Configuration Menu options should be set as follows:

a. **Auth Server Address**—Enter the IP address of the RADIUS server that will be used for EAP-TLS authentication.

b. **Auth Server Port**—Enter the access port of the RADIUS server.

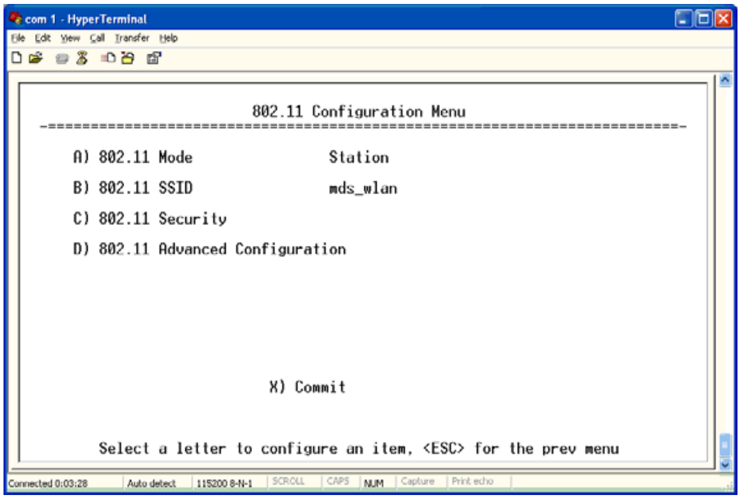
c. **Auth Server Shared Secret**—Enter the RADIUS server's shared secret. You will be prompted to reenter it for verification.

d. **User Auth Mode**—This is not used in WPA2 Enterprise and can be left as is.

4. Configuring the WiFi Station

Follow these steps to configure a second Remote with WiFi as a WiFi Station. Before you begin, ensure that the date is set properly on the device. The RADIUS server may reject the authorization request if the date is not set. The date can be set in the Device Information Menu, accessed by pressing **G** at the Main Menu screen.

Press **B** at the Main Menu to access the Network Configuration Menu. From this menu, press **F** to access the 802.11 Configuration Menu (Figure 6-7).



```
                    802.11 Configuration Menu
-=========================================================================-
     A) 802.11 Mode                     Station
     B) 802.11 SSID                     mds_wlan
     C) 802.11 Security
     D) 802.11 Advanced Configuration



                         X) Commit

        Select a letter to configure an item, <ESC> for the prev menu
```

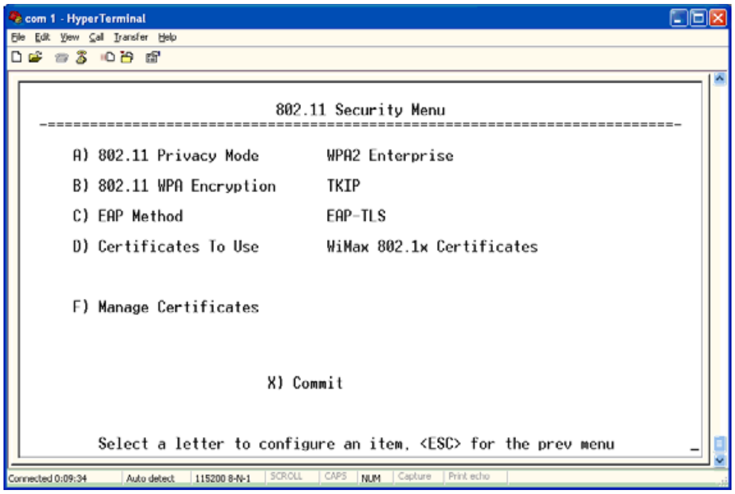
Figure 6-7. 802.11 Configuration Menu as a WiFi station

The setup for a WiFi station is as follows:

e. **802.11 Mode**—Select **Station**.

f. **802.11 SSID**—Enter the name you entered on the WiFi access point.

Press **X** to commit the changes. Next, press **C** to enter the 802.11 Security Menu.



```
                         802.11 Security Menu
-=========================================================================-
     A) 802.11 Privacy Mode             WPA2 Enterprise
     B) 802.11 WPA Encryption           TKIP
     C) EAP Method                      EAP-TLS
     D) Certificates To Use             WiMax 802.1x Certificates

     F) Manage Certificates


                         X) Commit

        Select a letter to configure an item, <ESC> for the prev menu _
```

Figure 6-8. 802.11 Security Menu as a WiFi station

The following options need to be set on the 802.11 Security Menu.

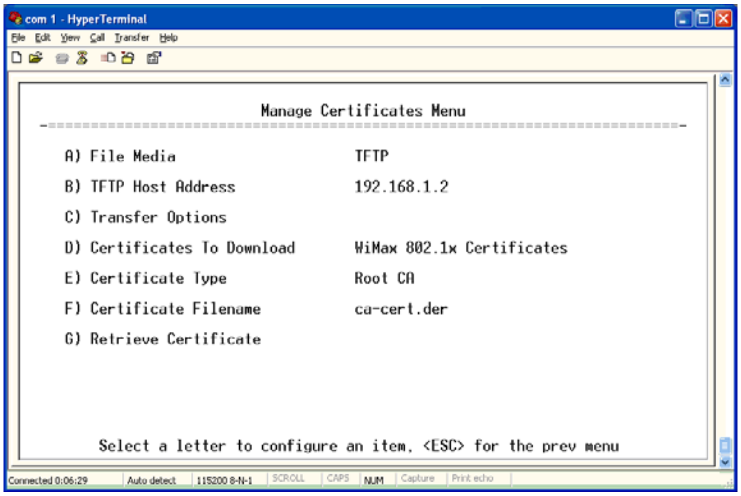
a. **802.11 Privacy Mode**—Select **WPA2 Enterprise**.

b. **802.11 WPA Encryption**—This must match the value selected on your WiFi AP.

c. **EAP Method**—Currently, EAP-TLS is the supported EAP method.

d. **Certificates to Use**—You have the option to designate the certificates you will use as WiMax certificates, which may also be used for 802.1x device authentication when initiating a WiMax connection to a Mercury Access Point, or as WiFi certificates, which will only be used for WiFi authentication. Please see the User Manual for more information on 802.1x device authentication.

Before committing your 802.11 Security Options, press **F** to go to the Manage Certificates Menu (Figure 6-9).



```
                         Manage Certificates Menu
-==========================================================================-

     A) File Media                        TFTP

     B) TFTP Host Address                 192.168.1.2

     C) Transfer Options

     D) Certificates To Download          WiMax 802.1x Certificates

     E) Certificate Type                  Root CA

     F) Certificate Filename              ca-cert.der

     G) Retrieve Certificate




         Select a letter to configure an item, <ESC> for the prev menu
```

Figure 6-9. Manage Certificates Menu

The Manage Certificates Menu allows you to install the certificates you will need for authentication. It contains the following parameters:

a. **File Media**—You may download your certificates through TFTP, or from a USB data storage device.

b. **TFTP Host Address**—If you selected **TFTP** above, enter the TFTP server's IP address here.

c. **Transfer Options**—You will enter the Transfer Options menu, where you can set TFTP timeout and block sizes.

d. **Certificates to Download**—Select the **Certificates to Use** option you chose on the 802.11 Security Menu.

e. **Certificate Type**—Press spacebar to switch between **Root Certificate**, **Client Certificate**, and **Private Key**. This is the certificate that will be downloaded when you press **G**. You must download all three certificates to successfully authenticate.

f. **Certificate Filename**—Enter the filename of the certificate you've selected. The certificate must be in **.der** format.

g. **Retrieve Certificate**—Press **G** to begin downloading the certificate. You will see a **Complete** message when the process is finished. If there is a problem with the certificate itself, you may also see an error message such as:

- **Common Name Mismatch**—The Common Name used to generate the certificate does not match your unit's serial number.
- **Invalid Cert**—This can occur when the wrong type of certificate was downloaded; for example, if a private key is downloaded when Client Certificate is specified in the Certificate Type field. This can also occur if the certificate is not in **.der** format.

When all three certificates are successfully downloaded, press Escape to go back to the 802.11 Security Menu.

Ensure that your security settings are correct and press **X** to commit them. The WiFi station will attempt to verify the certificate chain. If there is an error, you will see a message. You can access the Event Log through the Performance Information Menu for further details.

5. Network Operations

WiFi association will begin automatically if the certificates are valid on the WiFi station, the 802.11 configuration and security settings match on the WiFi access point and station, and the WiFi access point can connect to the RADIUS server. The WiFi station will send an authorization request, and the WiFi access point will begin communications with the RADIUS server. The RADIUS server will verify the station's certificates and allow it to join the WiFi network.

The diagram below shows the flow of data between the WiFi station, WiFi access point, and RADIUS server that occurs when the WiFi station associates with the network.

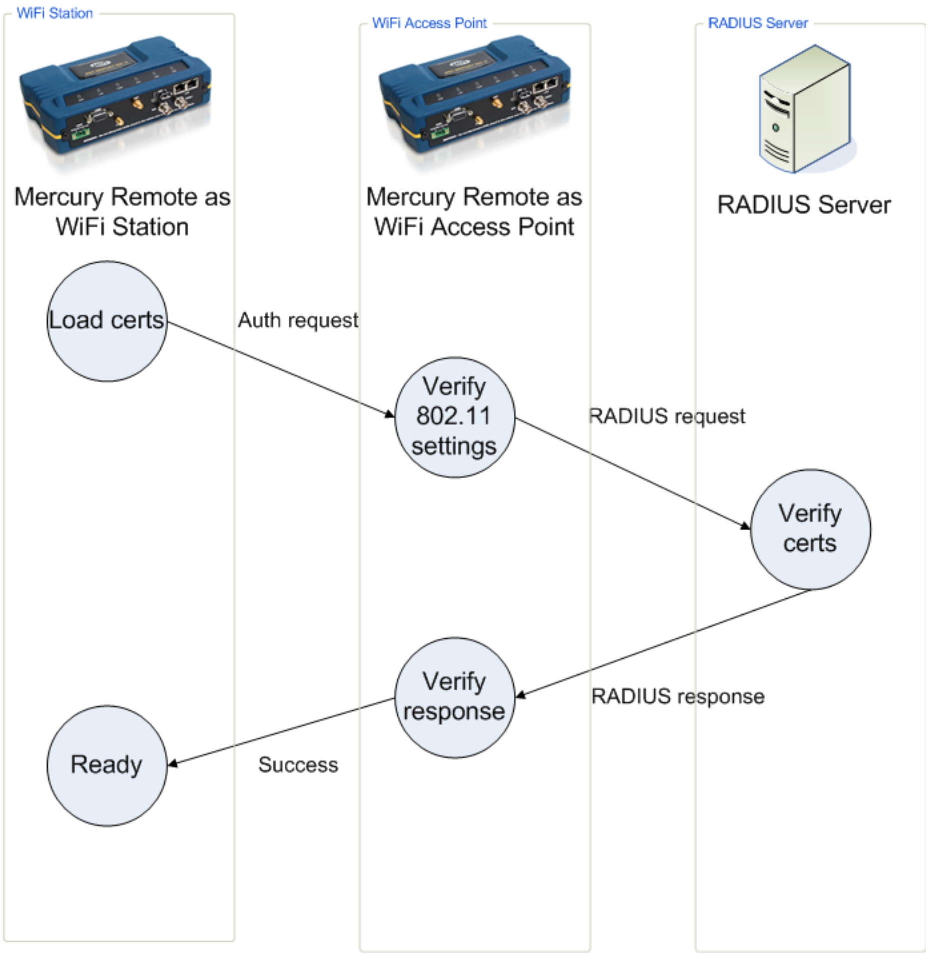
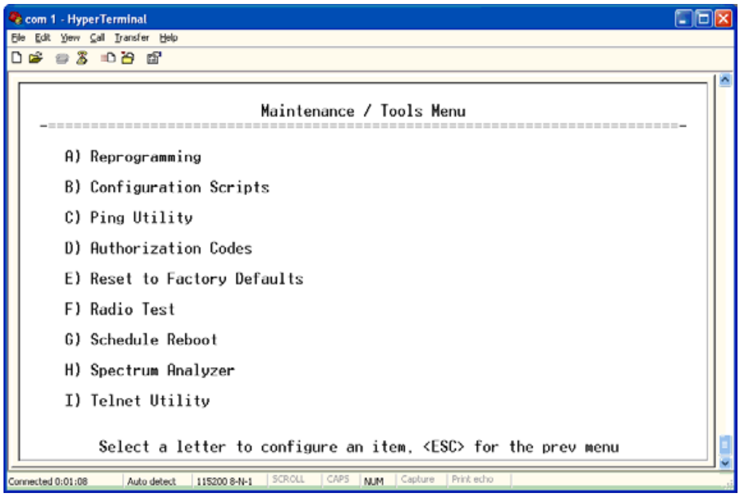


Figure 6-10. Authentication Data Flow Diagram

To verify that the authorization completed successfully, access the Ping Utility on the WiFi station. From the Main Menu, press **I** to reach the

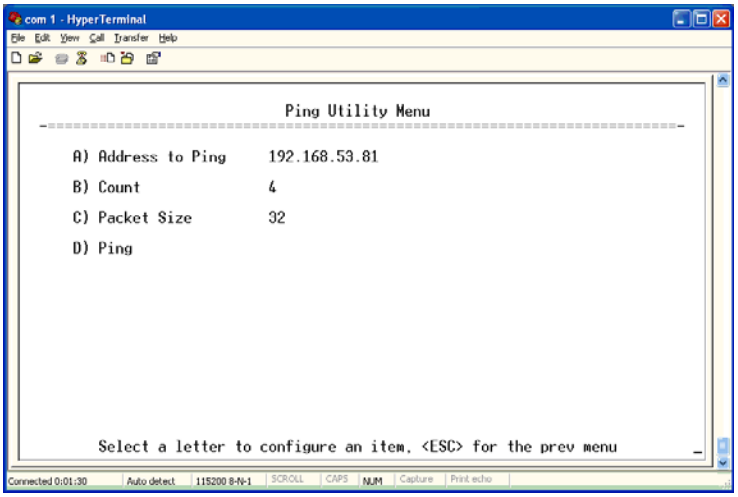
Maintenance/Tools Menu (Figure 6-11).



```
                    Maintenance / Tools Menu
 -==========================================================================-

     A) Reprogramming

     B) Configuration Scripts

     C) Ping Utility

     D) Authorization Codes

     E) Reset to Factory Defaults

     F) Radio Test

     G) Schedule Reboot

     H) Spectrum Analyzer

     I) Telnet Utility

        Select a letter to configure an item, <ESC> for the prev menu
```

Figure 6-11. Maintenance/Tools Menu

From the Maintenance/Tools Menu, press **C** to access the Ping Utility Menu (Figure 6-12).



```
                         Ping Utility Menu
 -==========================================================================-

      A) Address to Ping      192.168.53.81

      B) Count                4

      C) Packet Size          32

      D) Ping




        Select a letter to configure an item, <ESC> for the prev menu
```

Figure 6-12. Ping Utility Menu

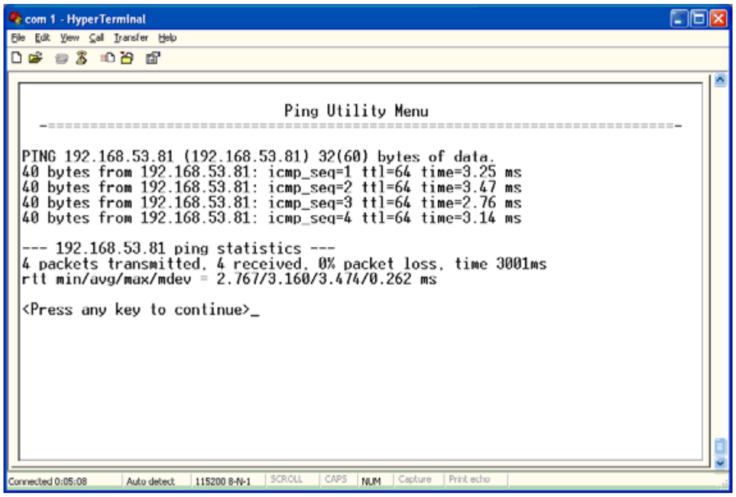
Set the Ping Utility options as follows.

a. **Address to Ping**—Enter the WiFi access point’s IP address.

b. **Count**—This is the number of pings to send. The default value is 4.

c. **Packet Size**—This is the size of the ping packet. The default value is 32.

Press **D** to ping the WiFi access point. A successful ping means that the WiFi station has successfully joined the WiFi network and results in a screen similar to Figure 6-13. This completes the steps in this section.



```
                              Ping Utility Menu
  -=========================================================================-

PING 192.168.53.81 (192.168.53.81) 32(60) bytes of data.
40 bytes from 192.168.53.81: icmp_seq=1 ttl=64 time=3.25 ms
40 bytes from 192.168.53.81: icmp_seq=2 ttl=64 time=3.47 ms
40 bytes from 192.168.53.81: icmp_seq=3 ttl=64 time=2.76 ms
40 bytes from 192.168.53.81: icmp_seq=4 ttl=64 time=3.14 ms

--- 192.168.53.81 ping statistics ---
4 packets transmitted, 4 received, 0% packet loss, time 3001ms
rtt min/avg/max/mdev = 2.767/3.160/3.474/0.262 ms

<Press any key to continue>_
```

Figure 6-13. Ping Utility Menu
(Successful Ping Results)

7 GLOSSARY OF TERMS AND ABBREVIATIONS

If you are new to wireless IP/Ethernet systems, some of the terms used in this manual might be unfamiliar. The following glossary explains many of these terms and will prove helpful in understanding the operation of your radio network. Some of these terms do not appear in the manual, but are often encountered in the wireless industry, and are therefore provided for completeness.

Access Point (AP)—The transceiver in the network that provides synchronization information to one or more associated Remote units. See *“Network Configuration Menu”* on Page 45.

AGC—Automatic Gain Control

Antenna System Gain—A figure, normally expressed in dB, representing the power increase resulting from the use of a gain-type antenna. System losses (from the feedline and coaxial connectors, for example) are subtracted from this figure to calculate the total antenna system gain.

AP—See *Access Point*

Association—Condition in which the frequency hopping pattern of the Remote is synchronized with the Access Point station, and the Remote is ready to pass traffic.

Authorization Key—Alphanumeric string (code) that is used to enable additional capabilities in the transceiver.

Bit—The smallest unit of digital data, often represented by a one or a zero. Eight bits usually comprise a byte.

Bits-per-second—See *BPS.*

BPDU—Bridge Protocol Data Units

BPS—Bits-per-second (bps). A measure of the information transfer rate of digital data across a communication channel.

Byte—A string of digital data made up of eight data bits.

CSMA/CA—Carrier Sense Multiple Access/Collision Avoidance

CSMA/CD—Carrier Sense Multiple Access/Collision Detection

Cyclic Redundancy Check (CRC)—A technique used to verify data integrity. It is based on an algorithm which generates a value derived from the number and order of bits in a data string. This value is compared with a locally-generated value and a match indicates that the message is unchanged, and therefore valid.

Data Circuit-terminating Equipment—See *DCE*.

Data Communications Equipment—See *DCE*.

Datagram—A data string consisting of an IP header and the IP message within.

Data Terminal Equipment—See *DTE*.

dBd—Decibels (dipole antenna).

dBi—Decibels referenced to an "ideal" isotropic radiator in free space. Frequently used to express antenna gain.

dBm—Decibels referenced to one milliwatt. An absolute unit used to measure signal power, as in transmitter power output, or received signal strength.

DCE—Data Circuit-terminating Equipment (or Data Communications Equipment). In data communications terminology, this is the "modem" side of a computer-to-modem connection. COM1 Port of the transceiver is set as DCE.

Decibel (dB)—A measure of the ratio between two signal levels. Frequently used to express the gain (or loss) of a system.

Delimiter—A flag that marks the beginning and end of a data packet.

Device Mode—The operating mode/role of a transceiver (Access Point or Remote) in a wireless network.

DHCP (Dynamic Host Configuration Protocol)—An Internet standard that allows a client (i.e. any computer or network device) to obtain an IP address from a server on the network. This allows network administrators to avoid the tedious process of manually configuring and managing IP addresses for a large number of users and devices. When a network device powers on, if it is configured to use DHCP, it will contact a DHCP server on the network and request an IP address.

The DHCP server will provide an address from a pool of addresses allocated by the network administrator. The network device may use this address on a "time lease" basis or indefinitely depending on the policy set by the network administrator. The DHCP server can restrict allocation of IP addresses based on security policies. An Access Point may be configured by the system administrator to act as a DHCP server if one is not available on the wired network.

Digital Signal Processing—See *DSP*.

DSP—Digital Signal Processing. DSP circuitry is responsible for the most critical real-time tasks; primarily modulation, demodulation, and servicing of the data port.

DTE—Data Terminal Equipment. A device that provides data in the form of digital signals at its output. Connects to the DCE device.

Encapsulation—Process in by which, a complete data packet, such as MODBUS™ frame or any other polled asynchronous protocol frame, is placed in the data portion of another protocol frame (in this case IP) to be transported over a network. Typically this action is done at the transmitting end, before being sent as an IP packet to a network. A similar reversed process is applied at the other end of the network extracting the data from the IP envelope, resulting in the original packet in the original protocol.

Endpoint—Data equipment connected to the Ethernet port of the radio.

Equalization—The process of reducing the effects of amplitude, frequency or phase distortion with compensating networks.

Fade Margin—The greatest tolerable reduction in average received signal strength that will be anticipated under most conditions. Provides an allowance for reduced signal strength due to multipath, slight antenna movement or changing atmospheric losses. A fade margin of 15 to 20 dB is usually sufficient in most systems.

Fragmentation—A technique used for breaking a large message down into smaller parts so it can be accommodated by a less capable media.

Frame—A segment of data that adheres to a specific data protocol and contains definite start and end points. It provides a method of synchronizing transmissions.

Frequency Hopping—The spread spectrum technique used by the transceiver, where two or more associated radios change their operating frequencies many times per second using a set pattern. Since the pattern appears to jump around, it is said to “hop” from one frequency to another.

GPS—Global Positioning System. A constellation of orbiting satellites used for navigation and timing data. Although 24 satellites are normally active, a number of spares are also available in case of malfunction. Originally designed for military applications by the U.S. Department of Defense, GPS was released for civilian use in the 1980s. GPS satellites operate in the vicinity of the “L” frequency band (1500 MHz).

Hardware Flow Control—A transceiver feature used to prevent data buffer overruns when handling high-speed data from the connected data communications device. When the buffer approaches overflow, the radio drops the clear-to-send (CTS) line, that instructs the connected device to delay further transmission until CTS again returns to the high state.

Host Computer—The computer installed at the master station site, that controls the collection of data from one or more remote sites.

HTTP—Hypertext Transfer Protocol

ICMP—Internet Control Message Protocol

IGMP (Internet Gateway Management Protocol)—Ethernet level protocol used by routers and similar devices to manage the distribution of multicast addresses in a network.

IEEE—Institute of Electrical and Electronic Engineers

IEEE 802.1Q—A standard for Ethernet framing which adds a four-byte tag after the Ethernet header. The four-byte tag contains a VLAN ID and a IEEE 802.1P priority value.

IEEE 802.1X—A standard for performing authentication and port blocking. The 802.1X port/device denies access to the network until the client device has authenticated itself.

Image (File)—Data file that contains the operating system and other essential resources for the basic operation of the radio's CPU.

LAN—Local Area Network

Latency—The delay (usually expressed in milliseconds) between when data is applied at the transmit port at one radio, until it appears at the receive port at the other radio.

MAC—Media Access Controller

MD5—A highly secure data encoding scheme. MD5 is a one-way hash algorithm that takes any length of data and produces a 128 bit "fingerprint." This fingerprint is "non-reversible," it is computationally infeasible to determine the file based on the fingerprint. For more details review "RFC 1321" available on the Internet.

MIB—Management Information Base

Microcontroller Unit—See *MCU*.

Mobility—Refers to a station that moves about while maintaining active connections with the network. Mobility generally implies physical motion. The movement of the station is not limited to a specific network and IP subnet. In order for a station to be mobile it must establish and tear down connections with various access points as it moves through the access points' territory.

Mode—*See Device Mode.*

MTBF—Mean-Time Between Failures

Multiple Address System (MAS)—See *Point-Multipoint System.*

NMEA—National Marine Electronics Association. National body that established a protocol for interfacing GPS data between electronic equipment.

Network Name—User-selectable alphanumeric string that is used to identify a group of radio units that form a communications network. The Access Point and all Remotes within a given system should have the same network address.

Network-Wide Diagnostics—An advanced method of controlling and interrogating GE MDS radios in a radio network.

NTP—Network Time Protocol

Packet—The basic unit of data carried on a link layer. On an IP network, this refers to an entire IP datagram or a fragment thereof.

PING—Packet INternet Groper. Diagnostic message generally used to test reachability of a network device, either over a wired or wireless network.

PKI—Private Key Infrastructure. A set of policies and technologies needed to create, store, and distribute Public Key Certificates used to protect the security of network communications.

Point-to-Multipoint System—A radio communications network or system designed with a central control station that exchanges data with a number of remote locations equipped with terminal equipment.

Poll—A request for data issued from the host computer (or master PLC) to a remote device.

Portability—A station is considered connected when it has successfully authenticated and associated with an access point. A station is considered authenticated when it has agreed with the access point on the type of encryption that will be used for data packets traveling between them. The process of association causes a station to be bound to an access point and allows it to receive and transmit packets to and from the access point. In order for a station to be associated it must first authenticate with the access point. The authentication and association processes occur automatically without user intervention.

Portability refers to the ability of a station to connect to an access point from multiple locations without the need to reconfigure the network settings. For example, a remote transceiver that is connected to an access point may be turned off, moved to new site, turned back on, and, assuming the right information is entered, can immediately reconnect to the access point without user intervention.

PLC—Programmable Logic Controller. A dedicated microprocessor configured for a specific application with discrete inputs and outputs. It can serve as a host or as an RTU.

PuTTY—A free implementation of Telnet and SSH for Win32 and Unix platforms. It is written and maintained primarily by Simon Tatham. Refer to http://www.pobox.com/~anakin/ for more information.

RADIUS—Remote Authentication Dial In User Service. An authentication, authorization, and accounting protocol used to secure remote access to a device or network.

Remote—A transceiver in a network that communicates with an associated Access Point.

Remote Terminal Unit—See *RTU*.

RFI—Radio Frequency Interference

Roaming—A station's ability to automatically switch its wireless connection between various access points (APs) as the need arises. A station may roam from one AP to another because the signal strength or quality of the current AP has degraded below what another AP can provide. Roaming may also be employed in conjunction with Portability where the station has been moved beyond the range of the original AP to which it was connected. As the station comes in range of a new AP, it will switch its connection to the stronger signal. Roaming refers to a station's logical, not necessarily physical, move between access points within a specific network and IP subnet.

RSSI—Received Signal Strength Indicator

RTU—Remote Terminal Unit. A data collection device installed at a remote radio site.

SCADA—Supervisory Control And Data Acquisition. An overall term for the functions commonly provided through an MAS radio system.

SNMP—Simple Network Management Protocol

SNR—Signal-to-Noise Ratio. A measurement of the desired signal to ambient noise levels.This measurement provides a relative indication of signal quality. Because this is a relative number, higher signal-to-noise ratios indicate improved performance.

SNTP—Simple Network Time Protocol

SSL—Secure Socket Layer

SSH—Secure Shell

STP—Spanning Tree Protocol

Standing-Wave Ratio—See *SWR*.

SWR—Standing-Wave Ratio. A parameter related to the ratio between forward transmitter power and the reflected power from the antenna system. As a general guideline, reflected power should not exceed 10% of the forward power (≈ 2:1 SWR).

TCP—Transmission Control Protocol

TFTP—Trivial File Transfer Protocol

Trap Manager—Software that collects SNMP traps for display or logging of events.

UDP—User Datagram Protocol

UTP—Unshielded Twisted Pair

VLAN—Virtual Local Area Network. A network configuration employing IEEE 802.1Q tagging, which allows multiple groups of devices to share the same physical medium while on separate broadcast domains.

Digital Energy
MDS

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IN CASE OF DIFFICULTY...

GE MDS products are designed for long life and trouble-free operation. However, this equipment, as with all electronic equipment, may have an occasional component failure. The following information will assist you in the event that servicing becomes necessary.

TECHNICAL ASSISTANCE

Technical assistance for GE MDS products is available from our Technical Support Department during business hours (8:00 A.M.—5:30 P.M. Eastern Time). When calling, please give the complete model number of the radio, along with a description of the trouble/symptom(s) that you are experiencing. In many cases, problems can be resolved over the telephone, without the need for returning the unit to the factory. Please use one of the following means for product assistance:

Phone: 585 241-5510   E-Mail: gemds.techsupport@ge.com

FAX: 585 242-8369   Web: www.gemds.com

FACTORY SERVICE

Component level repair of this equipment is not recommended in the field. Many components are installed using surface mount technology, which requires specialized training and equipment for proper servicing. For this reason, the equipment should be returned to the factory for any PC board repairs. The factory is best equipped to diagnose, repair and align your radio to its proper operating specifications.

If return of the equipment is necessary, you must obtain a Service Request Order (SRO) number. This number helps expedite the repair so that the equipment can be repaired and returned to you as quickly as possible. Please be sure to include the SRO number on the outside of the shipping box, and on any correspondence relating to the repair. No equipment will be accepted for repair without an SRO number.

SRO numbers are issued online at **www.gemds.com/support/product/sro/**. Your number will be issued immediately after the required information is entered. Please be sure to have the model number(s), serial number(s), detailed reason for return, □ship to□ address, □bill to□ address, and contact name, phone number, and fax number available when requesting an SRO number. A purchase order number or pre-payment will be required for any units that are out of warranty, or for product conversion.

If you prefer, you may contact our Product Services department to obtain an SRO number:

Phone Number: 585-241-5540
Fax Number: 585-242-8400
E-mail Address: productservices@GEmds.com

The radio must be properly packed for return to the factory. The original shipping container and packaging materials should be used whenever possible. All factory returns should be addressed to:

GE MDS, LLC
Product Services Department
(SRO No. XXXX)
175 Science Parkway
Rochester, NY 14620 USA

When repairs have been completed, the equipment will be returned to you by the same shipping method used to send it to the factory. Please specify if you wish to make different shipping arrangements. To inquire about an in-process repair, you may contact our Product Services Group using the telephone, Fax, or E-mail information given above.

GE MDS, LLC
175 Science Parkway
Rochester, NY 14620
General Business: +1 585 242-9600
FAX: +1 585 242-9620
Web: www.GEmds.com